RIZZO ASSOCIATES, INC.

ENGINEERS AND ENVIRONMENTAL SCIENTISTS

AIR QUALITY, NOISE, AND WIND
Boston College Alumni Stadium Addition
Boston, Massachusetts

Submitted to:
Boston College

Dec. 21

December 1993

RIZZO ASSOCIATES, INC.
ENGINEERS AND ENVIRONMENTAL SCIENTISTS
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December 17, 1993

Dr. James P. McIntyre
Senior Vice President
Boston College – Brock House
78 College Road
Chestnut Hill, MA 02167

Re: Boston College Alumni Stadium Addition
Air Quality, Noise, and Wind

Dear Dr. McIntyre:

As you requested, Rizzo Associates, Inc. has developed air quality and noise impact evaluations of the Boston College Alumni Stadium Addition Project based upon ongoing monitoring of traffic conditions during the 1993 football season. Also, as indicated in the *Draft Project Impact Report* (November 1993), we have prepared an analysis of the potential wind impacts of the Project.

Thank you for the continued opportunity to provide our professional services for this project. Please call if you have any questions.

Very truly yours,

Elizabeth K. Levin

Elizabeth K. Levin
Vice President

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Section

AIR QUALITY ANALYSIS FOR THE EXPANSION OF BOSTON COLLEGE ALUMNI STADIUM BOSTON, MASSACHUSETTS

Prepared for:

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December 7, 1993

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1.0 INTRODUCTION AND SUMMARY

Tech Environmental, Inc. conducted an air quality analysis for the proposed expansion of the Boston College Alumni Stadium in Boston, Massachusetts. This report satisfies the Article 31 requirements for an air quality analysis, as outlined in items IV.C.4 and IV.C.7(a) of the September 2, 1993 Scoping Determination. This analysis was performed using the latest available U.S. EPA models and followed procedures that were based on the latest Massachusetts Department of Environmental Protection (DEP) guidance. The methodology for the analysis was approved in advance by the Boston Redevelopment Authority (BRA) and was reviewed by the DEP. The results are summarized below.

1.1 MICROSCALE AIR QUALITY ANALYSIS

A microscale analysis was performed for the seven intersections near Boston College identified in the Scoping Determination for capacity analysis. Traffic volumes and vehicle speeds for peak Saturday game day conditions, combined with worst case meteorological conditions, were used to predict the maximum one-hour and eight-hour carbon monoxide (CO) concentrations (plus background) at sensitive receptors for two scenarios: 1993 Existing and 1994 Build. Transportation demand reduction measures and police officer control of some intersections were taken into account for both study scenarios.

Modeling was performed to determine the maximum concentration of CO at sensitive receptors at selected intersections. These maximum concentrations were compared to Massachusetts and National Ambient Air Quality Standards (NAAQS) for CO that have been established to protect the public health and welfare.

No violations of the one-hour (35 ppm) or eight-hour (9 ppm) Massachusetts and NAAQS for CO were predicted at any of the intersections for either the 1993 Existing or 1994 Build scenarios. Under the 1994 Build scenario, maximum one-hour and eight-hour CO concentrations were predicted to be 11.7 ppm and 8.2 ppm, respectively, and are generally about 5 percent lower than CO concentrations predicted for 1993. These worst case concentrations are all safely in compliance with health standards.

The microscale modeling analysis of seven intersections indicates that the proposed expansion of Boston College's Alumni Stadium will not cause or contribute to any violations of the NAAQS for CO in the project area. Therefore, the project will not cause any adverse effects on air quality.

1.2 CONSTRUCTION IMPACTS

The construction of the stadium expansion will result in a small temporary increase in air pollutant emissions between early 1994 and September 1994. Various mitigation measures will be used to reduce the impacts of fugitive dust (particulate matter) generated by excavation and truck hauling. Emissions of other pollutants from construction and workers'

personal vehicles will be relatively small. Due to the small amount of emissions and the mitigation plans, there will be no adverse air quality impacts in the residential areas next to the lower campus during construction.

2.0 MICROSCALE ANALYSIS

2.1 INTRODUCTION

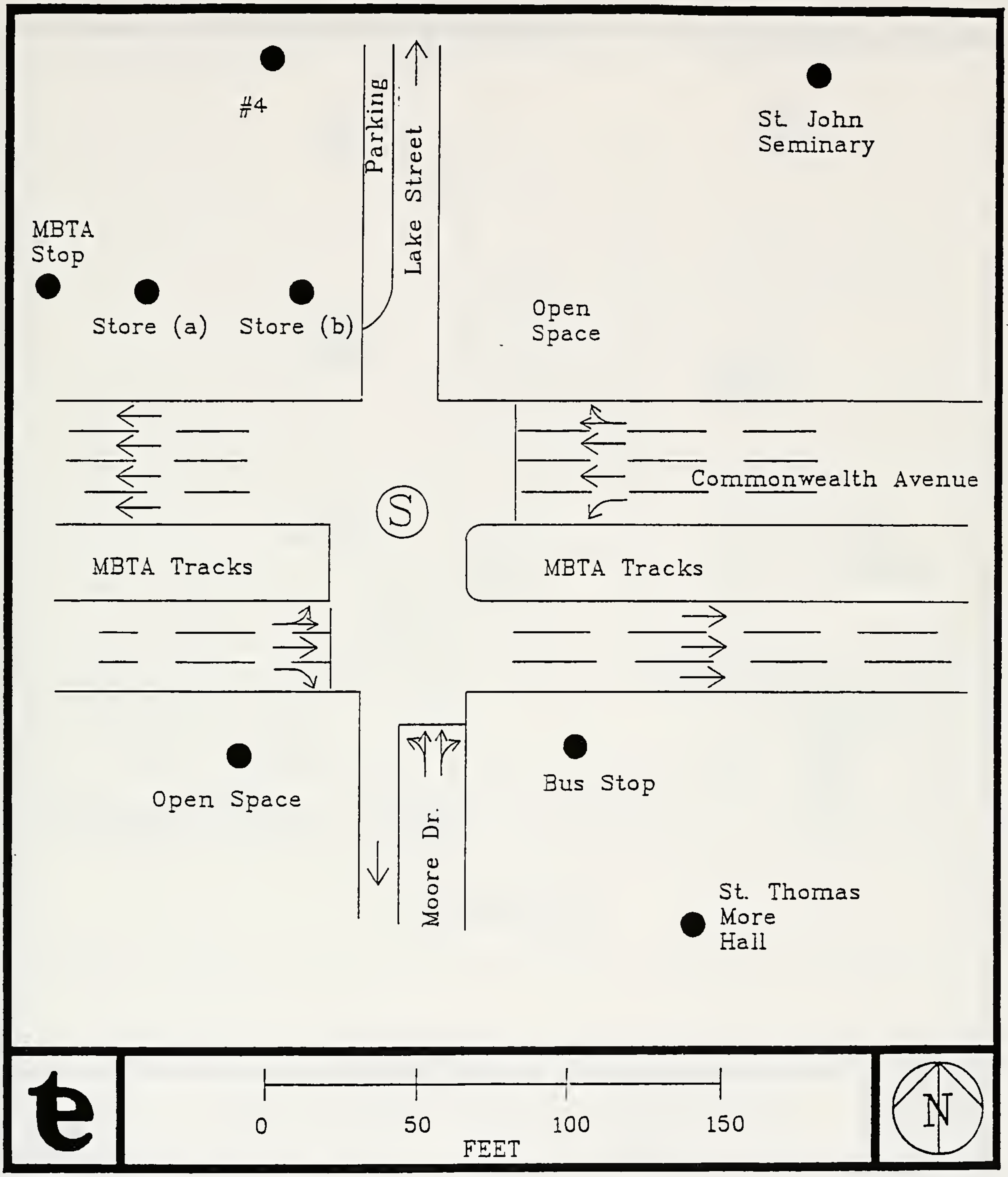
A microscale analysis was conducted to predict the maximum air quality impacts at seven intersections in the area of the proposed project. EPA models were used to predict the maximum one-hour and eight-hour average CO concentration at sensitive receptors at each intersection. The methodology for the analysis was approved in advance by the BRA (see Appendix D). Of the various air pollutants emitted by motor vehicles, CO was used in this analysis as an indicator of roadway air pollution levels since it is the most abundant and persistent pollutant emitted. Also, since CO is relatively nonreactive in ambient air, its concentration can be predicted more easily than pollutants that are more reactive.

The objective of the air quality analysis was to determine if the proposed stadium expansion will interfere with the attainment or maintenance of the Massachusetts and NAAQS for CO. To demonstrate compliance with these standards, it is necessary to identify those areas of human activity (sensitive receptors) exposed to maximum air pollutant levels from motor vehicle emissions in the project area. Using established air quality modeling techniques, CO levels were estimated at sensitive receptors for the Existing and future (1994) Build cases. Receptors are the locations where the CAL3QHC model predicts CO concentrations. Receptors were modeled on each intersection approach at locations where the general public will have access (stores, parks, residences, MBTA stops, etc.). Following EPA guidance all receptors were placed at a height of 1.8 meters and were located at least 3 meters (10 feet) from roadway curbsides. Detailed maps showing the location of each receptor at each intersection are included as Figures 1 through 7.

The microscale analysis methodology is described in detail in Appendix A.

2.2 AIR QUALITY STANDARDS FOR CARBON MONOXIDE

NAAQS for carbon monoxide have been set by the U.S. Environmental Protection Agency (EPA). Standards for the Commonwealth of Massachusetts are identical to the federal standards. The standards, intended to protect the public health and welfare, set a maximum concentration of 35 parts per million (ppm) for a one-hour period and 9 ppm for an eight-hour period, each not to be exceeded more than once per year. The city of Boston is currently classified by the U. S. EPA as a CO nonattainment area, although the last reported violation of the NAAQS for CO (eight-hour average) was in 1986.



Tech Environmental, Inc.

Reservoir Place
1601 Trapelo Road
Waltham, MA 02154

Figure 1: Receptors and Roadways Modeled for Commonwealth Avenue/Lake Street/Moore Drive.

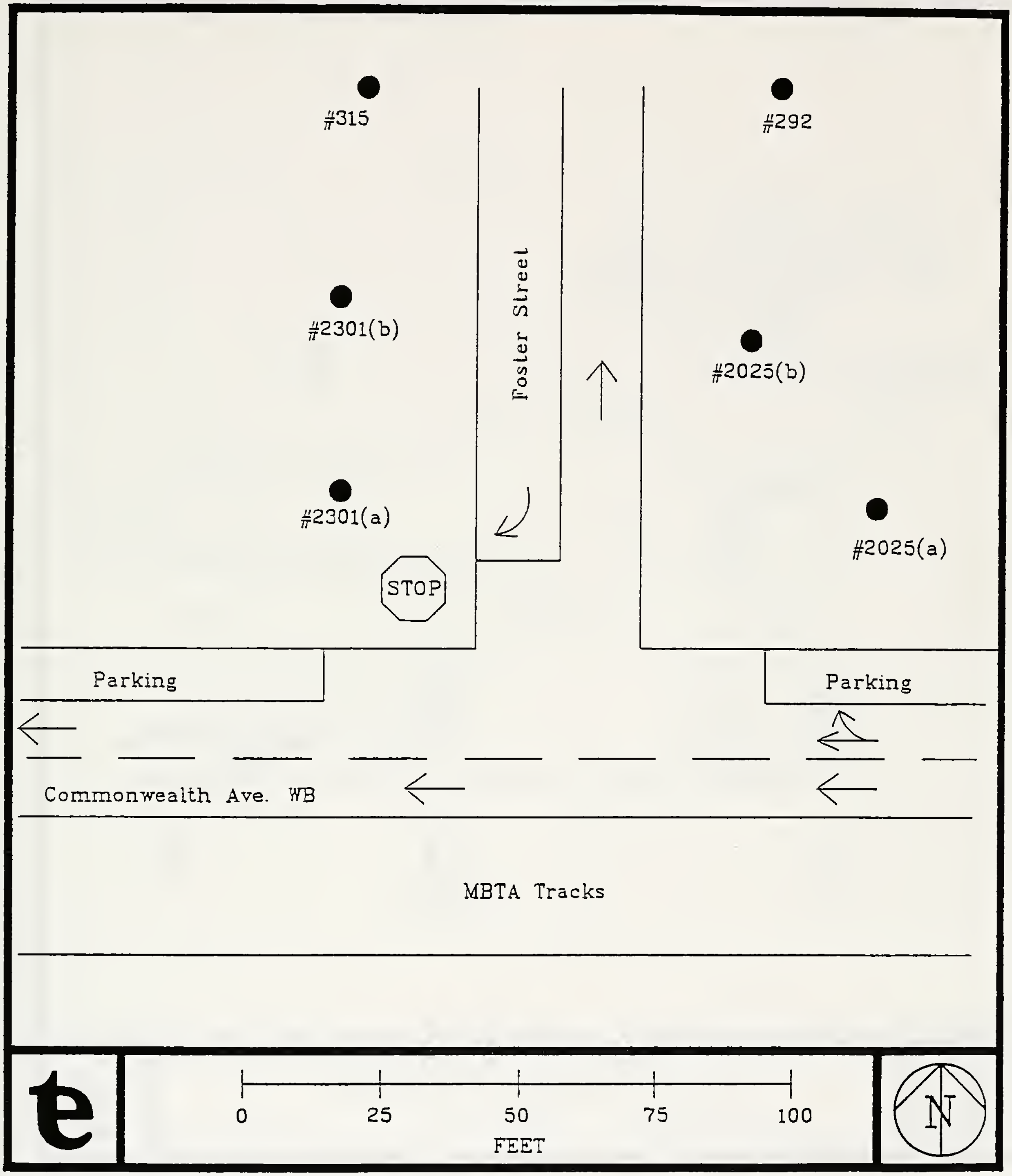


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Figure 2: Receptors and Roadways Modeled for Commonwealth Avenue/Foster Street.

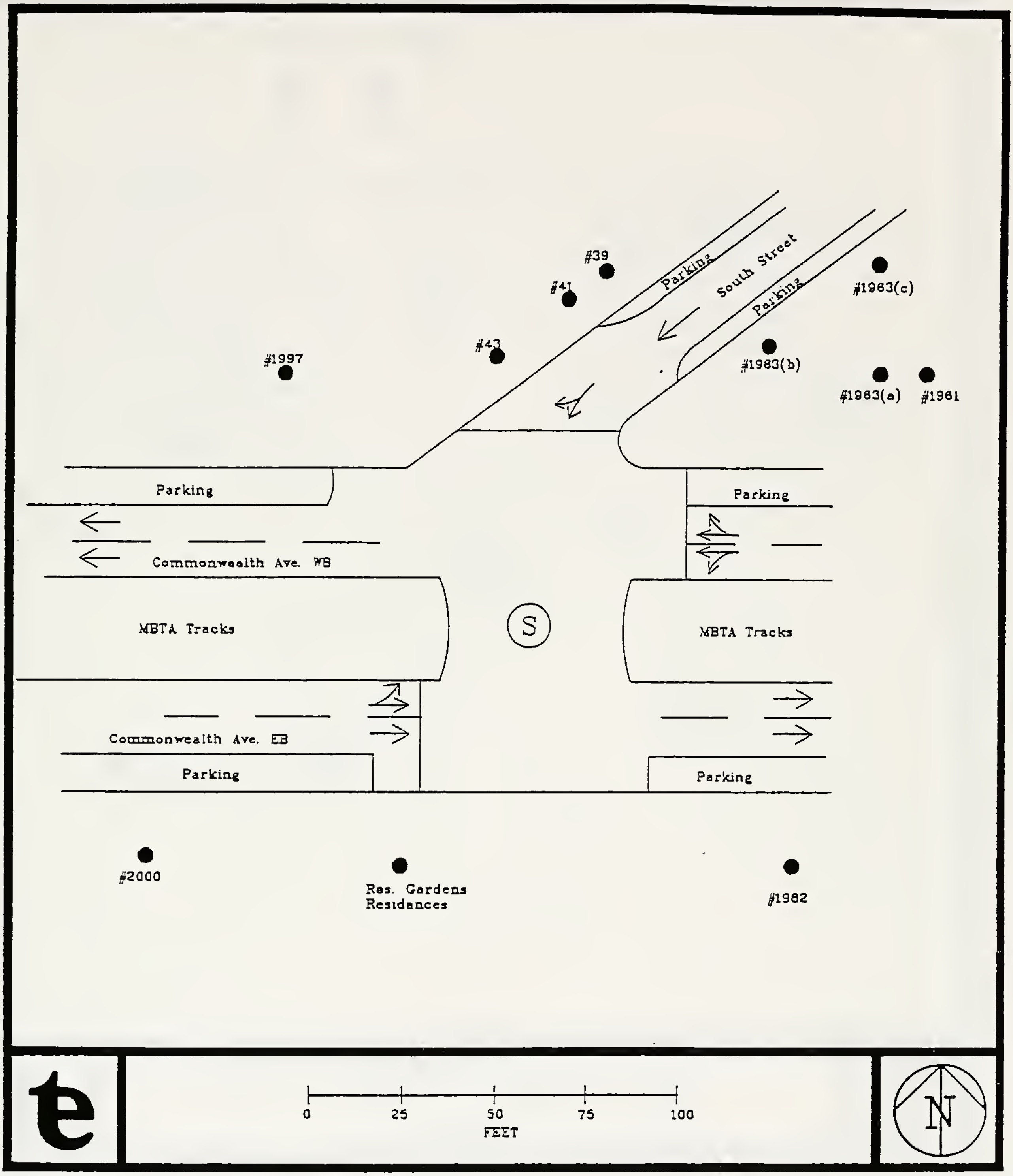

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Figure 3: Receptors and Roadways Modeled for Commonwealth Avenue/South Street.

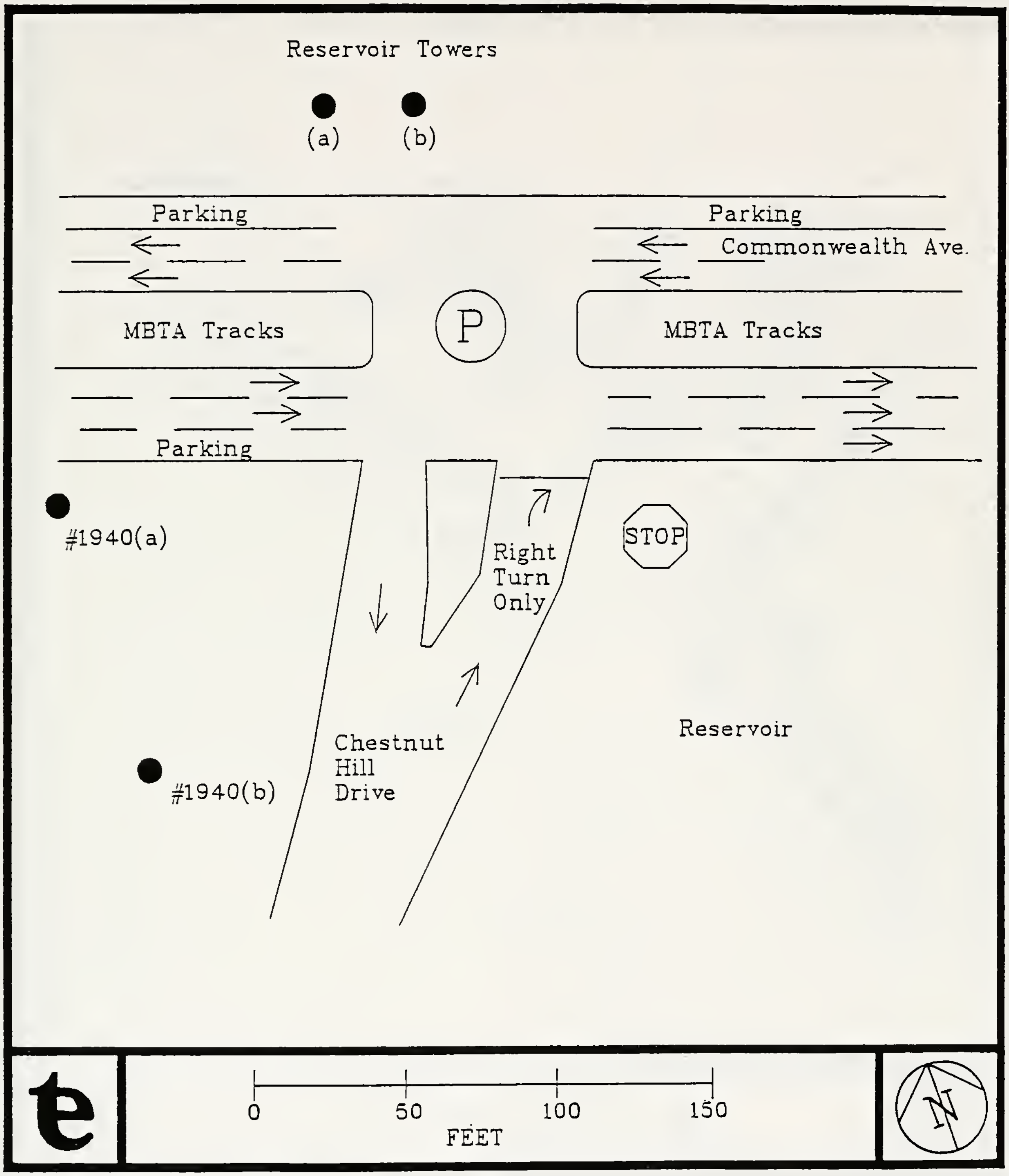

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Figure 4: Receptors and Roadways Modeled for Commonwealth Avenue/Chestnut Hill Drive (Police Officer Control).

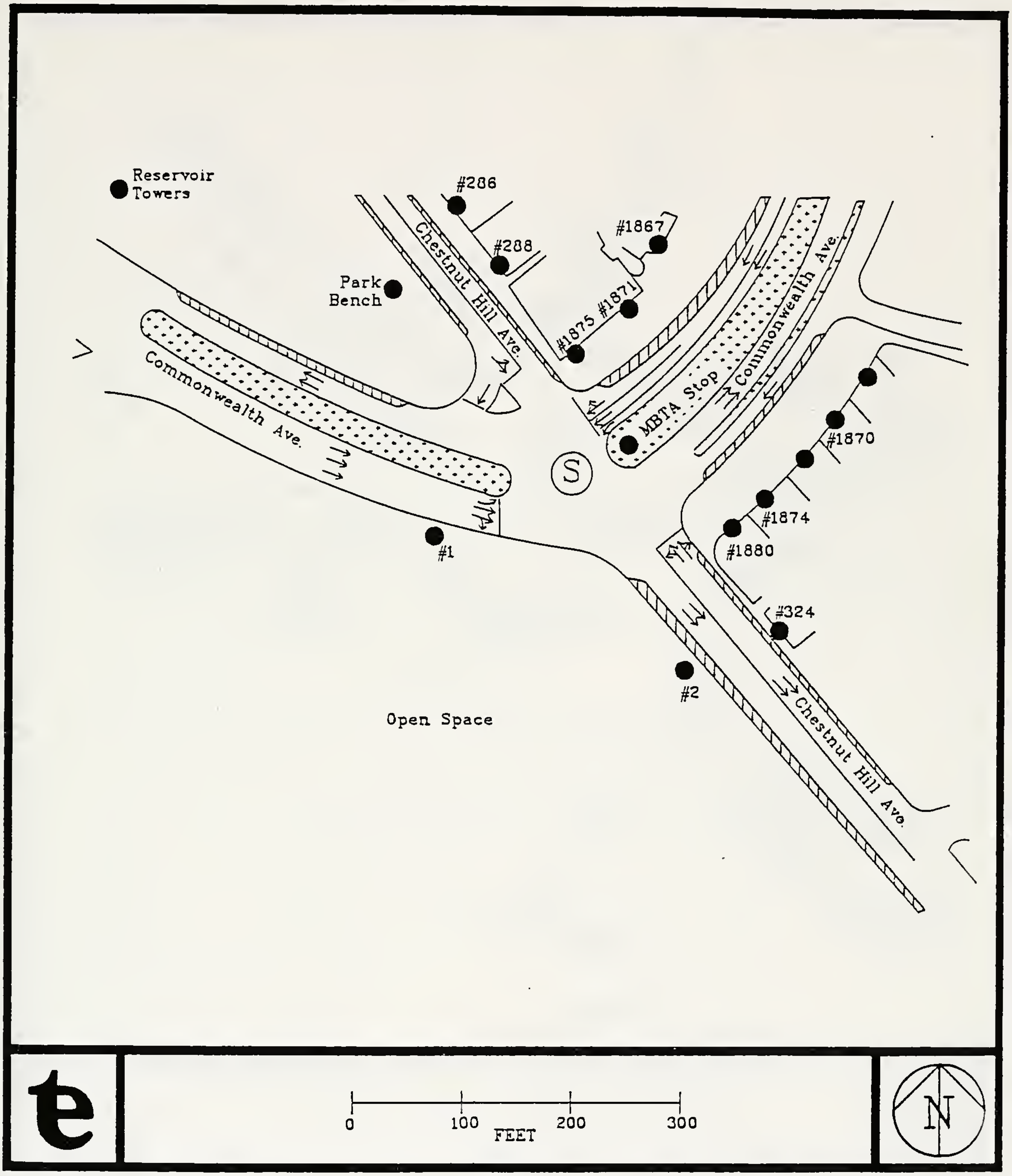

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Figure 5: Receptors and Roadways Modeled for Commonwealth Avenue/Chestnut Hill Avenue.

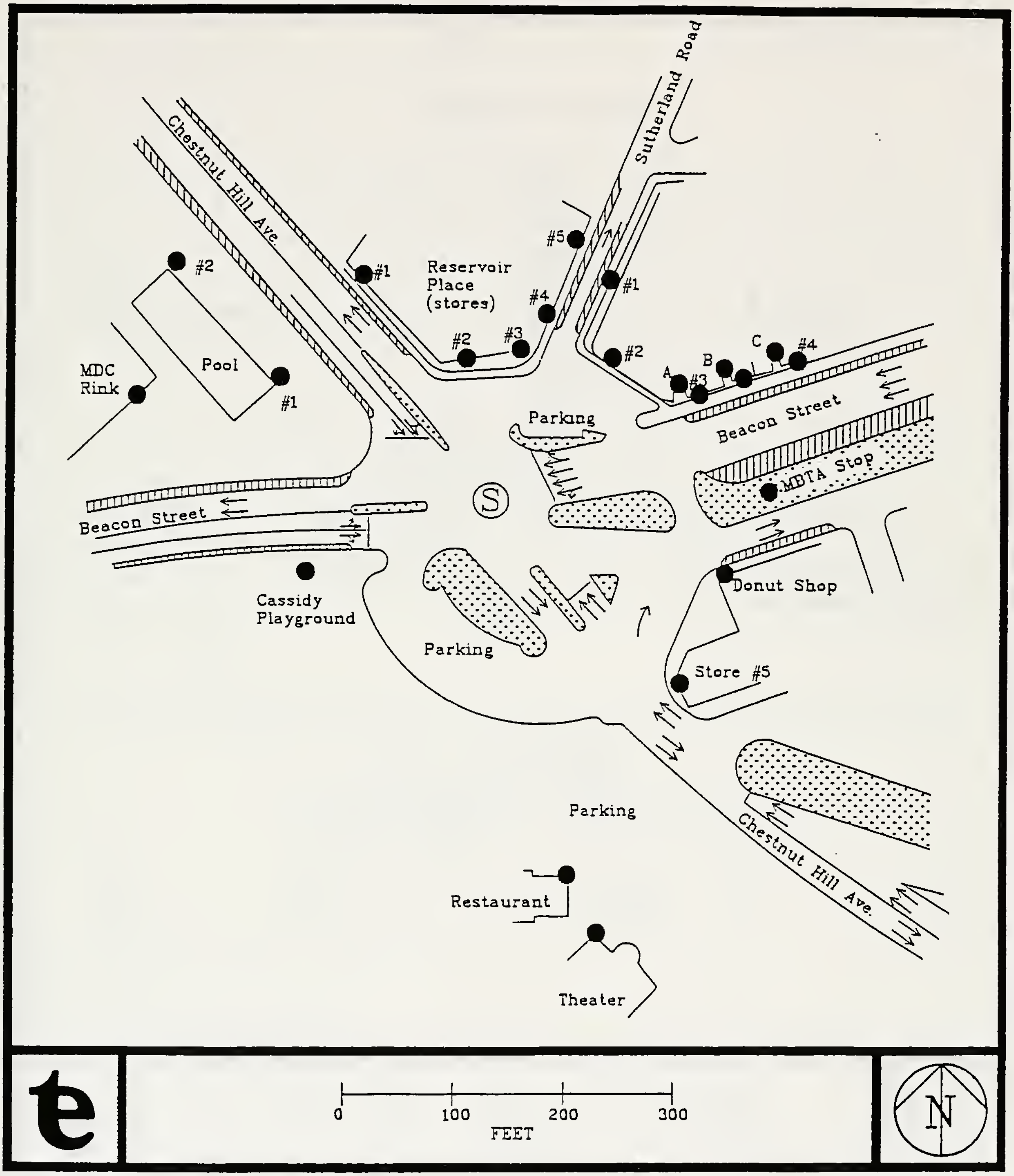

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Figure 6: Receptors and Roadways Modeled for Beacon Street/Chestnut Hill Avenue (Cleveland Circle).

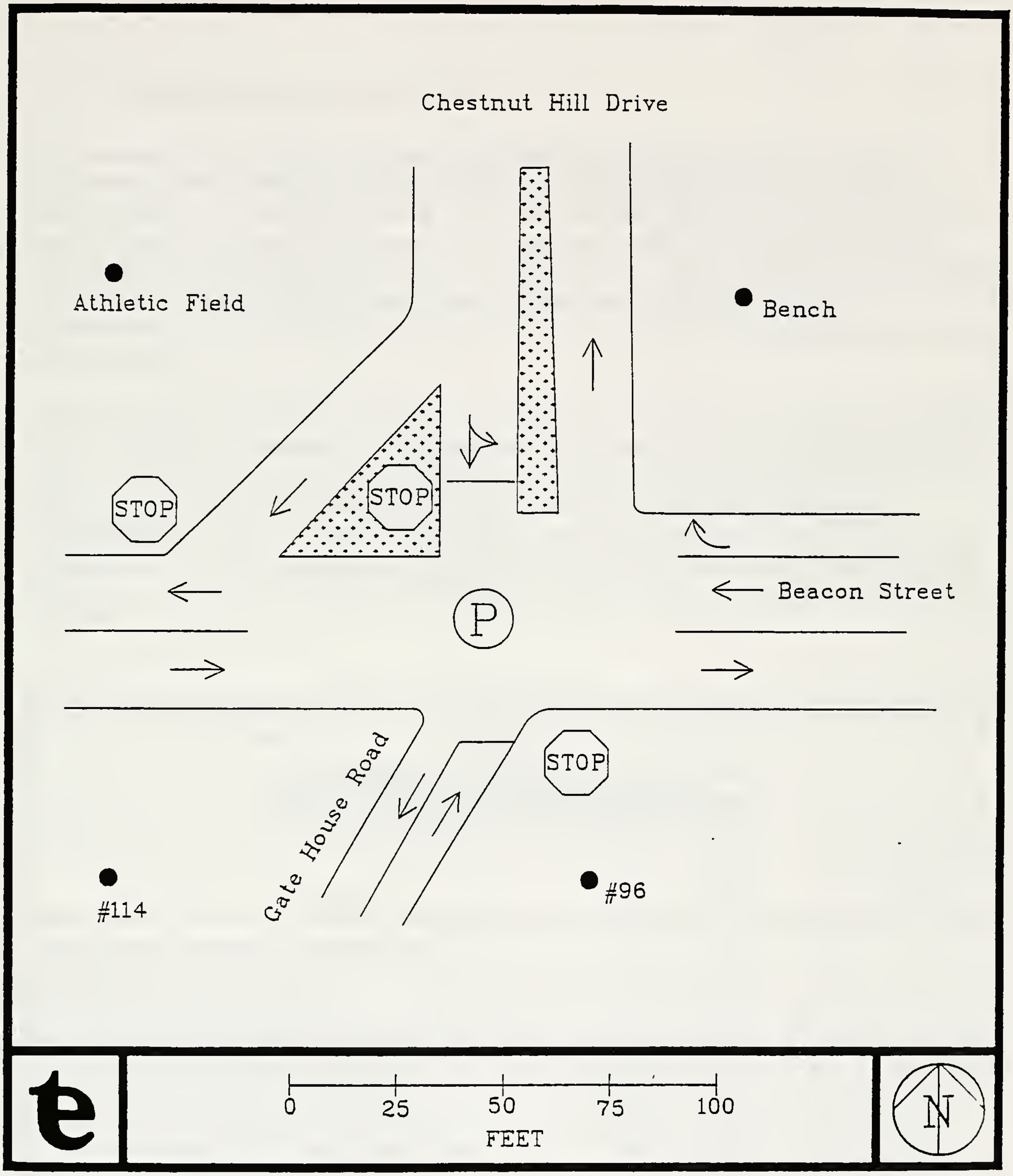

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Figure 7: Receptors and Roadways Modeled for Beacon Street/Chestnut Hill Drive (Police Officer Control).

2.3 *PREDICTED PROJECT IMPACTS*

The microscale intersection air quality analysis predicted maximum one-hour and eight-hour CO concentrations at sensitive receptors at seven intersections in the study area due to roadway traffic. The cumulative results of the one-hour and eight-hour air quality analyses, which consist of the sum of the impacts from intersection traffic and a background CO concentration, are presented in Tables 1 and 2, respectively. These results do not characterize typical air pollution levels in the project area. Rather, they represent the highest concentrations that could exist during the joint occurrence of worst-case meteorology and peak roadway traffic.

The model results presented in Tables 1 and 2 indicate a decrease in CO concentrations from 1993 to 1994 at each intersection. This decrease is expected as a larger portion of the motor vehicle population becomes equipped with improved CO emission control equipment and a larger portion of the vehicle population is held to stricter emission limits through the Commonwealth's Vehicle Inspection and Maintenance (I/M) program. Table A-3 in Appendix A shows the reduction in MOBILE5a composite (free flow) CO emission factors, and Table A-4 shows the reduction in MOBILE5a idle CO emission factors, between 1993 and 1994.

TABLE 1

MAXIMUM PREDICTED ONE-HOUR CARBON MONOXIDE CONCENTRATIONS AT SENSITIVE RECEPTORS (ppm)
(Plus Background of 3.0 ppm in 1993 and 2.9 ppm in 1994)

	1993	1994
Intersection	**Build**	**Build**
Commonwealth Avenue/Lake Street/Moore Drive	11.4	11.2
Commonwealth Avenue/Foster Street	6.5	6.4
Commonwealth Avenue/South Street	8.4	7.8
Commonwealth Avenue/Chestnut Hill Drive	7.6	7.2
Commonwealth Avenue/Chestnut Hill Avenue	11.9	11.7
Beacon Street/Chestnut Hill Avenue (Cleveland Circle)	11.4	9.7
Beacon Street/Chestnut Hill Drive	6.2	6.0
One-hour NAAQS	35.0	35.0

TABLE 2 MAXIMUM PREDICTED EIGHT-HOUR CARBON MONOXIDE CONCENTRATIONS AT SENSITIVE RECEPTORS (ppm) (Plus Background of 2.1 ppm in 1993 and 2.0 ppm in 1994)		
Intersection	**1993**	**Build**
Commonwealth Avenue/Lake Street/Moore Drive	8.0	7.8
Commonwealth Avenue/Foster Street	4.6	4.5
Commonwealth Avenue/South Street	5.9	5.5
Commonwealth Avenue/Chestnut Hill Drive	5.3	5.0
Commonwealth Avenue/Chestnut Hill Avenue	8.3	8.2
Beacon Street/Chestnut Hill Avenue (Cleveland Circle)	8.0	6.8
Beacon Street/Chestnut Hill Drive	4.3	4.2
Eight-hour NAAQS	9.0	9.0

2.3.1 1993 Existing Case

Maximum predicted one-hour CO concentrations for existing conditions ranged between 6.2 and 11.9 ppm. Maximum predicted eight-hour CO concentrations ranged between 4.3 and 8.3 ppm. The highest predicted one-hour and eight-hour CO concentrations were at the intersection of Commonwealth Avenue and Chestnut Hill Avenue. The maximum predicted one-hour and eight-hour CO concentrations predicted at every receptor is in compliance with the NAAQS for CO.

2.3.2 1994 Build Case

Maximum predicted one-hour CO concentrations for the 1994 Build case ranged between 6.0 and 11.7 ppm. Maximum predicted eight-hour CO concentrations ranged between 4.2 and 8.2 ppm. The highest predicted one-hour and eight-hour concentrations occurred at the same intersection identified for the Existing case. The maximum predicted one-hour and eight-hour CO concentrations predicted at every receptor are in compliance with the NAAQS for CO. These results demonstrate that the proposed expansion of Alumni Stadium will not cause or contribute to any violations of the NAAQS for CO in the vicinity of the stadium.

2.4 MITIGATION

Boston College has developed various transportation demand management measures to reduce the impact of football game traffic on nearby residents. These measures were put into effect for the 1993 football season and their impacts are included in both the 1993 Existing and 1994 Build analyses. These mitigation measures also include police officer control of four

intersections: Commonwealth Avenue/Lake Street/Moore Drive, Commonwealth Avenue/ Chestnut Hill Drive, Beacon Street/Chestnut Hill Avenue (Cleveland Circle), and Beacon Street, Chestnut Hill Drive.

3.0 CONSTRUCTION IMPACTS

Construction activity at the stadium will result in a small increase in air pollutant emissions from the Lower Campus during the construction period of early 1994 through September, 1994. A small amount of fugitive dust (particulate matter) will be generated by the excavation required to install spread footings, pile caps, and grade beams for the new stands at the stadium. A total excavation area of less than 10,000 square feet is assumed. Using EPA emission factors adjusted to the local precipitation/evaporation index, construction activity will release less than two pounds of dust per day into the air. As required by Massachusetts DEP Regulation 7.09, dust will be controlled during construction, as needed, by a water spray.

Additional, temporary air pollutant emissions on the Lower Campus will be released by trucks hauling material in or out of the site and construction worker vehicles parking on-site. It is estimated that construction trucks will generate 30 daily trips and worker vehicles will generate 120 daily trips. Using EPA emission factors for motor vehicles, the air pollutant emissions from vehicle operation on the site were calculated. Total air pollutant emissions, including fugitive dust from excavation, are estimated to be quite small:

Non-methane Hydrocarbons (NHMC)	0.2 kg/day
Carbon Monoxide (CO)	1.7 kg/day
Nitrogen Oxides (NO_x)	0.5 kg/day
Particulate Matter (PM)	0.9 kg/day

To mitigate the impact of these air pollutant emissions, the following measures will be used:

- The selected construction method, which involves minimal excavation for the foundations for the expanded stadium, will minimize the ground surface open to the wind and reduce fugitive dust emissions.

- Fugitive dust will also be controlled with water spray as needed during construction; no chemical soil stabilizers will be used.

- All trucks hauling demolition materials and excavate from the site will be covered.

- Fencing used around the perimeter of construction areas to shield the public will help to contain fugitive dust.

- Street sweeping will be used as needed to remove material from the Lower Campus roadways to reduce road dust emissions.

Based on the small amount of temporary emissions and the mitigation plan, there will be no adverse air quality impacts in the residential areas next to the lower campus.

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APPENDIX A

DETAILED INFORMATION FOR THE MICROSCALE MODELING ANALYSIS

MICROSCALE INTERSECTION ANALYSIS METHODOLOGY

The microscale air quality analysis calculated maximum one-hour and eight-hour CO concentrations at sensitive receptors near seven roadway intersections for the following two scenarios:

- 1993 Existing
- 1994 Build

The BRA requires a microscale analysis for CO at intersections that operate at level of service (LOS) D, where the project adds 10 percent or more to the traffic volumes, or for intersections that operate at LOS E or F. Using these criteria, the following five intersections were chosen for analysis:

1. Commonwealth Avenue/Lake Street/Moore Drive
2. Commonwealth Avenue/South Street
3. Commonwealth Avenue/Chestnut Hill Avenue
4. Beacon Street/Chestnut Hill Avenue (Cleveland Circle)
5. Beacon Street/Chestnut Hill Drive

Two additional intersections were also analyzed to include all of the intersections identified in the Scoping Determination for capacity analysis:

6. Commonwealth Avenue/Chestnut Hill Drive
7. Commonwealth Avenue/Foster Street

Predicted CO concentrations at these seven intersections under the two scenarios provides a good indication of whether the proposed project will interfere with the maintenance of the CO NAAQS in the area that could be impacted by traffic generated by the project. Since CO levels are highest near intersections where traffic congestion occurs, compliance with the NAAQS at these locations protects public health and welfare elsewhere in the community. The details of the technical approach can be found in Appendix A.

DISPERSION MODELING – ONE-HOUR AVERAGES

The EPA CAL3QHC[1] model (Version 2.0) was used to predict maximum one-hour CO concentrations at each intersection from both moving and idling vehicles. This model consists of the EPA CALINE-3 dispersion model[2], as well as methods for estimating queue lengths

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[1] U. S. EPA, *User's Guide to CAL3QHC, Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, Office of Air Quality Planning and Standards*, Research Triangle Park, September 1990.

[2] California Department of Transportation, *CALINE-3, A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets*, FHWA/CA/TL-79/23,

and the contribution of emissions from idling vehicles at intersections. Appendix B contains the CAL3QHC model output.

The CAL3QHC model requires the selection of a number of inputs. These inputs were chosen following U. S. EPA and Massachusetts DEP guidance and are presented below.

METEOROLOGICAL INPUTS

The following meteorological parameters were selected for the CAL3QHC modeling:

- Roughness Length: 370 cm (Apartment Residential)
- Mixing Height: 1,000 meters
- Wind Speed: 1.0 m/s (minimum)
- Wind Direction: 360° in 10° increments
- Stability Class: Class D

MODELED ROADWAYS

Each roadway approach was modeled as a free-flow line source with a length of 1,000 meters. The width of each free-flow link was set equal to the roadway width plus 3 meters on each side. Composite CO emission rates in units of mass per mile were applied to each free-flow link.

Each roadway approach controlled by a traffic signal, police officer, or a STOP sign was also modeled as a queue link. The width of each queue link was modeled as the actual approach lane width. The length of each queue was calculated by the CAL3QHC model.

Six of the intersections were modeled as signalized intersections. Four of these intersections will have police officer control. The CAL3QHC model requires the input of total and red signal time for signalized intersections to calculate queue lengths. Signal timings for each intersection were provided by Rizzo Associates, Inc. and can be found in Appendix A.

One intersection, Commonwealth Avenue/Foster Street, was modeled as an unsignalized intersection. For this intersection, turning movement capacities were provided by Rizzo Associates, Inc. from the Capacity of Intersection: Central Transportation Planning Staff Highway Capacity Manual (CINCH) Program. These capacities were used by the CAL3QHC model to calculate queue lengths using equations from EPA Volume 9[3] for under-

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Sacramento, CA, November 1979.

[3] U.S. EPA, *Guidelines for Air Quality Maintenance Planning and Analysis Volume 9 (revised): Evaluating Indirect Sources*, EPA- 450/4-78-001, Research Triangle Park, 1978.

capacity approaches, and an equation from NCHRP Report 133[4] for over-capacity approaches.

EIGHT-HOUR AVERAGE CO CONCENTRATIONS

Eight-hour average CO concentrations at each receptor were determined by multiplying the one-hour average values predicted by the CAL3QHC model by a factor of 0.7, and adding the appropriate CO background concentration. This procedure is approved by the EPA and was approved by the BRA. The application of a factor of 0.7 represents the fact that the worst case meteorological conditions modeled for the one-hour period will not persist for an entire eight-hour period.

BACKGROUND CO CONCENTRATIONS

The CO concentrations predicted by the CAL3QHC model were added to DEP-approved default suburban background CO concentrations of 3.0 ppm (one-hour average) and 2.1 ppm (eight-hour average) for the 1993 Existing case. For 1994, these conservative background CO concentrations were scaled, following EPA guidance[5], by the ratio of 1994 No-Build vehicle miles traveled (VMT) to 1993 VMT, and by the ratio of the MOBILE5a model predicted 1994 idle and free-flow emission rates to the MOBILE5a model predicted 1993 idle and free-flow emission rates. The sum of the CAL3QHC model predicted CO concentrations plus background were compared to the NAAQS for CO.

Detailed VMT data were not available for the study area. To be conservative, a 2 percent increase in VMT was assumed from 1993 to 1994. The idle CO emission rates (Table A-4) and the composite CO emission rates for 25 and 30 mph were compared for 1993 and 1994. Averaging the idle and free flow CO emission rate changes between 1993 and 1994 results in a general CO emission rate for 1994 which is approximately 95 percent of the rate for 1993. Combining the assumed 2.0 percent increase in VMT and the 5 percent reduction in CO emission rates results in a factor of 0.97 ($1.02 \times [0.95] = 0.97$) for scaling the 1993 one-hour and eight-hour CO concentrations for 1994. The resulting background CO concentrations used for this analysis are as follows:

	1993	1994
One-hour	3.0 ppm	2.9 ppm
Eight-hour	2.1 ppm	2.0 ppm

[4] Highway Research Board, *Procedures for Estimating Highway User Cost, Air Pollution and Noise Effects*, National Cooperative Highway Research Program Report 133, National Research Council, 1972.

[5] U. S. EPA, *Guideline for Modeling Carbon Monoxide from Roadway Intersections*, EPA-454 R-92-005, Office of Air Quality Planning and Standards, November 1992.

CO EMISSION FACTORS

The MOBILE5a Emission Factor Model[6] was used to predict the composite CO emission factors for moving (free flow) vehicles at each intersection and the idle emission factors for vehicles queued at traffic signals. Idle emission factors were estimated, following the latest U. S. EPA guidance[7], from the MOBILE5a composite emission factors (grams/mile) predicted for a speed of 2.5 mph. These grams per mile emission factors were multiplied by a speed of 2.5 mph to convert to idle emission factors of grams per hour. Output from the MOBILE5a model is included as Appendix C.

The input parameters used for the MOBILE5a model are consistent with those required by the latest DEP guidance issued in August 1993. This guidance allows credit to be taken for an inspection and maintenance (I/M) program and Stage II (vehicle refueling) emission controls. Other options selected with the MOBILE models include the following:

- Model default national annual mileage accumulation rate
- Massachusetts specific motor vehicle registration by age distribution
- Average wintertime temperature of 30°F
- Cold/hot-start mix of 20.6 percent/27.3 percent

MOBILE5a predicted free-flow emission rates are sensitive to vehicle speeds. Free-flow CO emission rates decrease with increasing speed, at speeds below 45 mph. Peak one-hour conditions for the free flow links were modeled with speeds at the speed limit. Table A-3 shows traffic speeds and free flow CO emission rates for each approach at each intersection. Table A-4 shows the idle CO emission rates for each year.

The MOBILE5a CO emission rates calculated for this analysis take into account the reduction in CO emissions mandated by revised federal tailpipe standards in the 1990 Amendments to the Clean Air Act. These revisions establish a more strict tailpipe standard for CO under cold temperature conditions, the conditions for which this analysis was done, and lower CO emissions for light-duty trucks. Massachusetts has also elected to adopt the more strict California tailpipe standards. Those reductions were not credited in this analysis since the Legislature could reverse its decision. The CO emission factors calculated for this analysis also do not take credit for the reformulated gasoline and enhanced I/M programs that the Clean Air Amendment of 1990 requires for "serious" ozone nonattainment areas such as Massachusetts. Legislation to establish an enhanced I/M program in Massachusetts is currently being considered in the Massachusetts House and Senate.

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[6] MOBILE5a is the "corrected" version of the MOBILE5.0 model and was released March 26, 1993. Only chapter two of the MOBILE5.0 User's Guide is available at this time.

[7] U. S. EPA, "MOBILE5 Information Sheet #2: Estimating Idle Emission Factors Using MOBILE5", Ann Arbor, July 30, 1993.

also do not take credit for the reformulated gasoline and enhanced I/M programs that the Clean Air Amendment of 1990 requires for "serious" ozone nonattainment areas such as Massachusetts. Legislation to establish an enhanced I/M program in Massachusetts is currently being considered in the Massachusetts House and Senate.

TRAFFIC AND ROADWAY INFORMATION

The microscale intersection analysis utilized peak one-hour traffic volumes. One-hour traffic volumes were provided by Rizzo Associates, Inc. for the peak hour before and after a football game. For each intersection, the period with the lowest levels of service (LOS) was modeled to simulate worst case conditions.

Roadway geometry and traffic control for each intersection is described in Tables A-5 through A-12. The geometry for each intersection remains the same for both scenarios.

TABLE A-1

NATIONWIDE AVERAGE MOTOR VEHICLE MIX BY TYPE FOR 1993 AND 1994 - MOBILE5a MODEL

Vehicle Type	Percent of Vehicle Miles Traveled 1993	1994
Light-Duty Gasoline Vehicles (LDGV)	62.5	62.1
Light-Duty Gasoline Trucks 0-6000 lb GVW* (LDGT1)	18.2	18.5
Over 6000 lb GVW (LDGT2)	8.5	8.6
Heavy-Duty Gasoline Vehicles (HDGV)	3.8	3.8
Light-Duty Diesel Vehicles (LDDV)	0.4	0.3
Light-Duty Diesel Trucks (LDDT)	0.2	0.1
Heavy-Duty Diesel Vehicles (HDDV)	5.9	6.1
Motorcycles (MC)	0.5	0.5
Total Percent	100.0	100.0

* Gross vehicle weight

TABLE A-2

COLD/HOT START VEHICLE MODES FOR THE MOBILE5a MODEL

	1-Hour
Cold Start	20.6%
Hot Start	27.3%
Hot Stabilized	52.1%
Total	100.0%

TABLE A-3

MOBILE5a COMPOSITE CO EMISSIONS RATES (GRAMS/MILE) FOR PEAK ONE-HOUR PERIOD

Roadway Approach	Speed (mph)/CO Emission Rate 1993	1994
Commonwealth Avenue/Lake Street/Moore Drive		
Commonwealth Avenue	30/25.6	30/24.5
Lake Street	25/29.7	25/28.7
Moore Street	15/44.6	15/43.1
Commonwealth Avenue/Foster Street		
Commonwealth Avenue	30/25.6	30/24.5
Foster Street	25/29.7	25/28.7
Commonwealth Avenue/South Street		
Commonwealth Avenue	30/25.6	30/24.5
South Street	25/29.7	25/28.7
Commonwealth Avenue/Chestnut Hill Drive		
Commonwealth Avenue	30/25.6	30/24.5
Chestnut Hill Drive	15/44.6	15/43.1
Commonwealth Avenue/Chestnut Hill Avenue		
Commonwealth Avenue	30/25.6	30/24.5
Chestnut Hill Avenue (north)	25/29.7	25/28.7
Chestnut Hill Avenue (south)	15/44.6	15/43.1
Beacon Street/Chestnut Hill Avenue (Cleveland Circle)		
Beacon Street (east)	30/25.6	30/24.5
Beacon Street (west)	30/25.6	30/24.5
Chestnut Hill Avenue (north)	15/44.6	15/43.1
Chestnut Hill Avenue (south)	15/44.6	15/43.1
Beacon Street/Chestnut Hill Drive		
Beacon Street (east)	30/25.6	30/24.5
Beacon Street (west)	25/29.7	25/28.7
Chestnut Hill Drive	20/35.8	20/35.0
Gate House Road	10/61.8	10/58.9

TABLE A-4

MOBILE5a MODEL IDLE CO EMISSION RATES FOR THE ONE-HOUR PERIOD

grams/hour	
1993	1994
516.8	478.1

TABLE A-5

INTERSECTION DATA FOR COMMONWEALTH AVENUE/LAKE STREET/MOORE DRIVE

Approach	Number of Lanes	Movements	Average Red Signal Time (sec)* 1993	1994
Commonwealth Avenue EB	1	Left/Thru	113	114
Commonwealth Avenue EB	1	Thru	96	98
Commonwealth Avenue EB	1	Right	96	98
Commonwealth Avenue WB	1	Left	116	117
Commonwealth Avenue WB	2	Thru	99	101
Commonwealth Avenue WB	1	Thru/Right	99	101
Moore Drive	1	Left	78	75
Moore Drive	1	Thru/Right	78	75
Pedestrian All-Red			30	30

* Average Total Signal Time = 130 seconds for 1993 and 1994 - Police Officer Control.

TABLE A-6

INTERSECTION DATA FOR
COMMONWEALTH AVENUE/FOSTER STREET

Approach	Number of Lanes	Movements	Traffic Control*
Commonwealth Avenue WB	1	Thru	Free Flow
Commonwealth Avenue WB	1	Thru/Right	Free Flow
Foster Street	1	Right	Stop Sign

* See Table A-14 for turning movement capacities.

TABLE A-7

INTERSECTION DATA FOR COMMONWEALTH AVENUE/SOUTH STREET

Approach	Number of Lanes	Movements	Average Red Signal Time (sec)* 1993	1994
Commonwealth Avenue EB	1	Left/Thru	46	39
Commonwealth Avenue EB	1	Thru	46	39
Commonwealth Avenue WB	1	Left/Thru	46	39
Commonwealth Avenue WB	1	Thru/Right	46	39
South Street	1	Left/Thru/Right	66	73
Pedestrian All-Red			23	23

* Average Total Signal Time = 89 seconds for 1993 and 1994.

TABLE A-8

INTERSECTION DATA FOR COMMONWEALTH AVENUE/CHESTNUT HILL DRIVE

Approach	Number of Lanes	Movements	Average Red Signal Time (sec)* 1993	1994
Commonwealth Avenue EB	1	Left/Thru	52	52
Commonwealth Avenue EB	1	Thru	52	52
Commonwealth Avenue WB	1	Left/Thru	52	52
Commonwealth Avenue WB	1	Thru	52	52
Chestnut Hill Drive	1	Left/Right	68	68
Pedestrian All-Red			29	29

* Average Total Signal Time = 91 seconds for 1993 and 1994 - Police Officer Control.

TABLE A-9

INTERSECTION DATA FOR
COMMONWEALTH AVENUE/CHESTNUT HILL AVENUE

Approach	Number of Lanes	Movements	Average Red Signal Time (sec)* 1993	1994
Commonwealth Avenue EB	1	Left	99	98
Commonwealth Avenue EB	1	Thru	102	101
Commonwealth Avenue EB	1	Thru/Right	81	81
Commonwealth Avenue WB	1	Left	107	107
Commonwealth Avenue WB	1	Thru	110	110
Commonwealth Avenue WB	1	Thru/Right	110	110
Chestnut Hill Avenue NB	1	Left	109	110
Chestnut Hill Avenue NB	1	Thru/Right	51	52
Chestnut Hill Avenue SB	1	Left/Thru	72	72
Chestnut Hill Avenue SB	1	Right	72	72

* Average Total Signal Time = 130 seconds for 1993 and 1994.

TABLE A-10

INTERSECTION DATA FOR BEACON STREET/CHESTNUT HILL AVENUE (CLEVELAND CIRCLE)

Approach	Number of Lanes	Movements	Average Red Signal Time (sec)* 1993	1994
Beacon Street EB	1	Left/Thru	96	96
Beacon Street EB	1	Thru/Right	96	96
Beacon Street WB	1	Left	77	77
Beacon Street WB	2	Thru	77	77
Beacon Street WB	1	Right	77	77
Chestnut Hill Avenue NB	1	Left/Thru	66	66
Chestnut Hill Avenue NB	1	Thru	66	66
Chestnut Hill Avenue NB	1	Right	66	66
Chestnut Hill Avenue SB	1	Left/Thru	66	66
Chestnut Hill Avenue SB	1	Thru/Right	66	66
Pedestrian All-Red			15	15

* Average Total Signal Time = 128 seconds for 1993 and 1994 - Police Officer Control.

TABLE A-11

INTERSECTION DATA FOR BEACON STREET/CHESTNUT HILL DRIVE

Time Approach	Number of Lanes	Movements	Average Red Signal (sec)* 1993	1994
Beacon Street EB	1	Left/Thru/Right	49	49
Beacon Street WB	1	Left/Thru/Right	49	49
Chestnut Hill Drive	1	Left/Thru	88	88
Chestnut Hill Drive	1	Right	88	88
Gate House Road	1	Left/Thru/Right	88	88
Pedestrian All-Red			17	17

* Average Total Signal Time = 120 seconds for 1993 and 1994 - Police Office Control.

TABLE A-12

UNSIGNALIZED INTERSECTION CAPACITIES FOR
THE PEAK ONE-HOUR PERIOD (Passenger cars per hour)*

Intersection Traffic Movement	1993	1994 Build
Foster Street (and Commonwealth Avenue)		
Right Turn	607	588

* Source: Rizzo Associates, Inc.

APPENDIX B

CAL3QHC MODEL OUTPUT

JOB: COMMONWEALTH AVE./LAKE ST./MOORE DR. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 15:14:28

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 3.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST WB FF	0.0	7.6	1000.0	7.6	1000.	90.	AG	897.	25.6	0.0	18.2		
2. COMM AVE EAST EB FF	0.0	-10.7	1000.0	-10.7	1000.	90.	AG	537.	25.6	0.0	15.1		
3. COMM AVE WEST WB FF	0.0	7.6	-1000.0	7.6	1000.	270.	AG	895.	25.6	0.0	18.2		
4. COMM AVE WEST EB FF	0.0	-10.7	-1000.0	-10.7	1000.	270.	AG	745.	25.6	0.0	15.1		
5. LAKE ST. FREE FLOW	5.3	0.0	5.3	1000.0	1000.	360.	AG	632.	29.7	0.0	10.6		
6. MOORE DR. FREE FLOW	5.3	0.0	5.3	-1000.0	1000.	180.	AG	664.	44.6	0.0	12.9		
7. COMM AVE EB LT QUEUE	-3.0	-7.6	-333.0	-7.6	330.	270.	AG	1205.	100.0	0.0	3.7	1.53	55.0
8. COMM AVE EB T/R QUEU	-3.0	-12.2	-43.0	-12.2	40.	270.	AG	2047.	100.0	0.0	7.3	0.68	6.7
9. COMM AVE WB LT QUEUE	15.2	3.0	52.5	3.0	37.	90.	AG	1237.	100.0	0.0	3.0	0.98	6.2
10. COMM AVE WB T/R QUEU	15.2	9.1	278.8	9.1	264.	90.	AG	2111.	100.0	0.0	6.1	1.17	43.9
11. MOORE DRIVE QUEUE	7.2	-18.3	7.2	-53.5	35.	180.	AG	1663.	100.0	0.0	6.1	0.46	5.9

JOB: COMMONWEALTH AVE./LAKE ST./MOORE DR. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 15:14:28

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
7. COMM AVE EB LT QUEUE	130	113	2.0	245	1600	516.80	3	3
8. COMM AVE EB T/R QUEU	130	96	2.0	500	1600	516.80	3	3
9. COMM AVE WB LT QUEUE	130	116	2.0	120	1600	516.80	3	3
10. COMM AVE WB T/R QUEU	130	99	2.0	777	1600	516.80	3	3
11. MOORE DRIVE QUEUE	130	78	2.0	543	1600	516.80	3	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. STORE (A)	-21.3	24.4	1.8
2. STORE (B)	-6.1	24.4	1.8
3. #4 LAKE STREET	-9.1	47.2	1.8
4. ST. JOHN SEMINARY	45.7	45.7	1.8
5. ST. THOM MORE HALL	33.5	-38.1	1.8
6. OPEN SPACE	-12.2	-21.3	1.8
7. MBTA STOP	-54.9	24.4	1.8
8. BUS STOP	27.4	-24.4	1.8

JOB: COMMONWEALTH AVE./LAKE ST./MOORE DR.   RUN: 1993 EXISTING POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8
0.	3.3	3.5	3.4	3.2	6.1	10.8	3.1	6.8
10.	3.4	3.7	3.5	3.1	6.0	10.9	3.2	6.9
20.	3.4	3.6	3.5	3.0	5.7	10.5	3.2	6.7
30.	3.3	3.6	3.5	3.0	5.5	10.2	3.2	6.7
40.	3.3	3.5	3.5	3.0	5.4	10.0	3.2	6.8
50.	3.3	3.5	3.4	3.0	5.4	9.9	3.2	6.6
60.	3.3	3.5	3.4	3.0	5.6	9.7	3.2	6.6
70.	3.7	3.9	3.4	3.0	5.4	9.5	3.6	6.4
80.	5.1	5.2	3.8	3.3	4.8	8.7	4.5	5.9
90.	6.8	7.3	4.7	4.1	3.9	7.5	5.9	4.8
100.	8.1	8.8	5.8	5.3	3.3	6.3	6.7	3.6
110.	7.4	8.9	6.4	5.9	3.0	5.9	6.8	3.1
120.	6.4	7.9	6.6	6.0	3.0	5.9	6.6	3.0
130.	5.8	7.0	6.2	5.7	3.0	5.9	7.0	3.0
140.	5.8	5.8	6.0	5.5	3.0	5.6	7.1	3.0
150.	6.5	5.9	5.6	5.6	3.0	5.1	6.8	3.0
160.	7.3	6.3	5.7	5.6	3.0	4.6	6.2	3.0
170.	7.5	6.9	6.1	5.9	3.2	4.1	5.6	3.2
180.	7.2	7.3	6.0	6.4	3.4	3.7	5.2	3.5
190.	6.9	6.9	5.7	6.7	3.6	3.3	4.9	3.9
200.	6.3	6.7	5.4	7.0	3.6	3.1	4.7	4.2
210.	6.0	6.7	5.1	7.0	3.6	3.0	4.9	4.7
220.	5.6	6.4	4.7	6.5	3.8	3.0	5.0	5.2
230.	5.3	6.0	4.5	6.2	4.1	3.0	5.1	5.5
240.	5.4	5.7	4.4	5.4	4.4	3.0	5.3	5.8
250.	5.3	5.5	4.5	4.9	4.8	3.4	5.3	6.2
260.	5.1	5.2	4.2	4.6	5.7	4.8	5.1	7.1
270.	4.4	4.5	3.6	4.0	7.0	7.2	4.3	8.9
280.	3.6	3.6	3.2	3.4	8.0	9.3	3.6	9.7
290.	3.1	3.1	3.0	3.2	8.3	10.8	3.1	8.8
300.	3.0	3.0	3.0	3.2	7.6	11.3	3.0	7.1
310.	3.0	3.0	3.0	3.2	6.6	11.4	3.0	5.8
320.	3.0	3.0	3.0	3.2	5.6	11.0	3.0	5.2
330.	3.0	3.0	3.0	3.2	5.2	10.7	3.0	5.2
340.	3.0	3.1	3.1	3.3	5.2	10.6	3.0	5.8
350.	3.1	3.3	3.2	3.3	5.8	10.8	3.0	6.4
360.	3.3	3.5	3.4	3.2	6.1	10.8	3.1	6.8
MAX	8.1	8.9	6.6	7.0	8.3	11.4	7.1	9.7
DEGR.	100	110	120	200	290	310	140	280

THE HIGHEST CONCENTRATION IS 11.40 PPM AT 310 DEGREES FROM REC6 .

JOB: COMMONWEALTH AVE./LAKE ST./MOORE DR. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 15:20:03

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 2.9 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST WB FF	0.0	7.6	1000.0	7.6	1000.	90.	AG	886.	24.5	0.0	18.2		
2. COMM AVE EAST EB FF	0.0	-10.7	1000.0	-10.7	1000.	90.	AG	590.	24.5	0.0	15.1		
3. COMM AVE WEST WB FF	0.0	7.6	-1000.0	7.6	1000.	270.	AG	929.	24.5	0.0	18.2		
4. COMM AVE WEST EB FF	0.0	-10.7	-1000.0	-10.7	1000.	270.	AG	809.	24.5	0.0	15.1		
5. LAKE ST. FREE FLOW	5.3	0.0	5.3	1000.0	1000.	360.	AG	706.	28.7	0.0	10.6		
6. MOORE DR. FREE FLOW	5.3	0.0	5.3	-1000.0	1000.	180.	AG	768.	43.1	0.0	12.9		
7. COMM AVE EB LT QUEUE	-3.0	-7.6	-436.6	-7.6	434.	270.	AG	1125.	100.0	0.0	3.7	1.80	72.3
8. COMM AVE EB T/R QUEU	-3.0	-12.2	-50.6	-12.2	48.	270.	AG	1933.	100.0	0.0	7.3	0.79	7.9
9. COMM AVE WB LT QUEUE	15.2	3.0	79.0	3.0	64.	90.	AG	1154.	100.0	0.0	3.0	1.07	10.6
10. COMM AVE WB T/R QUEU	15.2	9.1	343.4	9.1	328.	90.	AG	1993.	100.0	0.0	6.1	1.25	54.7
11. MOORE DRIVE QUEUE	7.2	-18.3	7.2	-58.8	41.	180.	AG	1480.	100.0	0.0	6.1	0.52	6.8

JOB: COMMONWEALTH AVE./LAKE ST./MOORE DR. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 15:20:03

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
7. COMM AVE EB LT QUEUE	*	130	114	2.0	264	1600	478.10	3	3
8. COMM AVE EB T/R QUEU	*	130	98	2.0	545	1600	478.10	3	3
9. COMM AVE WB LT QUEUE	*	130	117	2.0	118	1600	478.10	3	3
10. COMM AVE WB T/R QUEU	*	130	101	2.0	768	1600	478.10	3	3
11. MOORE DRIVE QUEUE	*	130	75	2.0	649	1600	478.10	3	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (M) X	Y	Z	*
1. STORE (A)	*	-21.3	24.4	1.8	*
2. STORE (B)	*	-6.1	24.4	1.8	*
3. #4 LAKE STREET	*	-9.1	47.2	1.8	*
4. ST. JOHN SEMINARY	*	45.7	45.7	1.8	*
5. ST. THOM MORE HALL	*	33.5	-38.1	1.8	*
6. OPEN SPACE	*	-12.2	-21.3	1.8	*
7. MBTA STOP	*	-54.9	24.4	1.8	*
8. BUS STOP	*	27.4	-24.4	1.8	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8
0.	*	3.2	3.5	3.4	3.1	5.9	10.4	3.0	6.6
10.	*	3.3	3.6	3.5	3.0	5.8	10.4	3.1	6.5
20.	*	3.3	3.6	3.5	2.9	5.7	10.0	3.1	6.6
30.	*	3.2	3.5	3.4	2.9	5.8	9.9	3.1	6.7
40.	*	3.2	3.5	3.4	2.9	5.7	9.7	3.1	6.7
50.	*	3.2	3.4	3.3	2.9	5.7	9.7	3.1	6.9
60.	*	3.2	3.4	3.3	2.9	5.6	9.6	3.1	7.0
70.	*	3.6	3.8	3.3	2.9	5.5	9.3	3.5	6.7
80.	*	4.9	5.1	3.7	3.3	4.9	8.7	4.5	6.1
90.	*	7.0	7.3	4.7	4.2	4.0	7.6	6.1	4.8
100.	*	8.0	8.9	5.8	5.4	3.3	6.4	6.8	3.6
110.	*	7.4	8.9	6.5	5.8	2.9	5.7	6.7	3.1
120.	*	6.3	7.9	6.6	5.8	2.9	5.7	6.4	2.9
130.	*	5.5	6.8	6.3	5.8	2.9	5.7	7.0	2.9
140.	*	5.7	5.8	5.9	5.7	2.9	5.6	7.0	2.9
150.	*	6.4	5.6	5.4	5.8	2.9	5.2	7.1	2.9
160.	*	7.0	6.2	5.4	5.9	2.9	4.7	6.7	3.0
170.	*	7.4	6.9	6.0	6.1	3.1	4.2	6.1	3.1
180.	*	7.2	7.1	5.9	6.4	3.3	3.7	5.6	3.6
190.	*	6.8	6.8	5.6	6.7	3.5	3.2	5.1	4.0
200.	*	6.4	6.5	5.4	6.8	3.5	3.0	4.8	4.4
210.	*	6.1	6.5	5.0	6.6	3.7	2.9	4.7	4.8
220.	*	5.9	6.5	4.8	6.2	3.9	2.9	4.9	5.2
230.	*	5.4	6.0	4.4	5.9	4.3	2.9	4.9	5.5
240.	*	5.3	5.7	4.4	5.4	4.6	2.9	5.1	5.6
250.	*	5.2	5.4	4.4	4.9	4.9	3.4	5.2	5.9
260.	*	5.1	5.1	4.2	4.6	5.7	4.9	5.0	6.9
270.	*	4.3	4.3	3.6	3.9	6.8	7.4	4.3	8.8
280.	*	3.6	3.6	3.1	3.3	7.9	9.7	3.5	9.5
290.	*	3.0	3.0	2.9	3.1	8.1	10.9	3.0	8.5
300.	*	2.9	2.9	2.9	3.1	7.6	11.2	2.9	7.0
310.	*	2.9	2.9	2.9	3.1	6.3	11.1	2.9	5.6
320.	*	2.9	2.9	2.9	3.1	5.4	10.6	2.9	5.1
330.	*	2.9	2.9	2.9	3.2	4.9	10.3	2.9	5.1
340.	*	2.9	3.0	3.0	3.2	5.0	10.1	2.9	5.6
350.	*	3.0	3.2	3.1	3.2	5.6	10.3	2.9	6.1
360.	*	3.2	3.5	3.4	3.1	5.9	10.4	3.0	6.6
MAX	*	8.0	8.9	6.6	6.8	8.1	11.2	7.1	9.5
DEGR.	*	100	100	120	200	290	300	150	280

THE HIGHEST CONCENTRATION IS 11.20 PPM AT 300 DEGREES FROM REC6 .

JOB: COMMONWEALTH AVENUE/FOSTER STREET RUN: 1993 EXISTING PRE-GAME ONE-HOUR
DATE: 11/22/93
TIME: 10:14:53

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 3.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST WB FF	-4.6	0.0	995.4	0.0	1000.	90.	AG	1288.	25.6	0.0	15.1		
2. COMM AVE WEST WB FF	-4.6	0.0	-1004.6	0.0	1000.	270.	AG	1248.	25.6	0.0	15.1		
3. FOSTER ST. FREE FLOW	-4.6	0.0	-4.6	1000.0	1000.	360.	AG	750.	29.7	0.0	15.1		
4. FOSTER ST. RT QUEUE	-6.5	9.1	-6.5	17.6	8.	360.	AG	1386.	100.0	0.0	4.6	0.58	1.4

JOB: COMMONWEALTH AVENUE/FOSTER STREET RUN: 1993 EXISTING PRE-GAME ONE-HOUR
DATE: 11/22/93
TIME: 10:14:53

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	APPROACH VOL (VPH)	CAPACITY (VPH)	IDLE EM FAC (gm/hr)
4. FOSTER ST. RT QUEUE	355	607.	516.80

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. #2301(A) COMM AVE	-16.8	13.0	1.8
2. #2301(B) COMM AVE	-16.8	23.6	1.8
3. #315 FOSTER STREET	-16.8	35.1	1.8
4. #292 FOSTER STREET	7.6	35.1	1.8
5. #2025(B) COMM AVE	6.1	21.3	1.8
6. #2025(B) COMM AVE	13.0	12.2	1.8

JOB: COMMONWEALTH AVENUE/FOSTER STREET RUN: 1993 EXISTING PRE-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6
0.	3.7	3.7	3.7	3.7	3.8	3.5
10.	3.9	3.9	3.9	3.3	3.4	3.2
20.	3.8	3.8	3.8	3.1	3.1	3.1
30.	3.9	3.8	3.8	3.0	3.0	3.0
40.	4.0	3.7	3.7	3.0	3.0	3.0
50.	4.2	3.6	3.6	3.0	3.0	3.0
60.	4.7	3.6	3.6	3.0	3.0	3.0
70.	5.2	3.6	3.6	3.0	3.1	3.2
80.	6.0	3.8	3.7	3.1	3.3	3.5
90.	6.4	4.3	4.0	3.4	3.6	4.0
100.	6.5	4.8	4.2	3.6	3.8	4.3
110.	6.0	5.0	4.2	3.6	3.8	4.2
120.	5.4	5.4	4.2	3.5	3.7	4.1
130.	4.7	5.6	4.4	3.5	3.7	4.0
140.	4.4	5.5	4.5	3.5	3.6	3.9
150.	4.1	5.1	4.7	3.4	3.6	3.9
160.	4.0	4.6	4.6	3.4	3.6	3.8
170.	3.9	4.1	4.2	3.5	3.7	3.8
180.	3.8	3.7	3.9	3.7	3.8	3.9
190.	3.8	3.5	3.6	4.0	3.9	3.8
200.	3.8	3.5	3.4	4.4	4.2	3.8
210.	3.8	3.6	3.4	4.6	4.6	4.0
220.	3.9	3.6	3.4	4.6	5.1	4.1
230.	3.9	3.6	3.5	4.5	5.5	4.4
240.	4.0	3.7	3.5	4.3	5.6	4.6
250.	4.1	3.7	3.5	4.2	5.5	5.1
260.	4.2	3.7	3.5	4.1	5.2	5.3
270.	3.9	3.5	3.4	4.0	4.6	5.4
280.	3.5	3.2	3.1	3.7	4.1	4.8
290.	3.1	3.0	3.0	3.6	3.7	4.2
300.	3.0	3.0	3.0	3.6	3.6	3.9
310.	3.0	3.0	3.0	3.6	3.7	3.6
320.	3.0	3.0	3.0	3.7	3.7	3.5
330.	3.0	3.0	3.0	3.8	3.8	3.6
340.	3.1	3.1	3.1	3.8	3.9	3.6
350.	3.3	3.3	3.3	3.9	4.0	3.6
360.	3.7	3.7	3.7	3.7	3.8	3.5
MAX	6.5	5.6	4.7	4.6	5.6	5.4
DEGR.	100	130	150	210	240	270

THE HIGHEST CONCENTRATION IS 6.50 PPM AT 100 DEGREES FROM REC1 .

JOB: COMMONWEALTH AVENUE/FOSTER STREET RUN: 1994 BUILD PRE-GAME ONE-HOUR
DATE: 11/22/93
TIME: 10:09:38

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 2.9 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST WB FF	-4.6	0.0	995.4	0.0	1000.	90.	AG	1346.	24.5	0.0	15.1		
2. COMM AVE WEST WB FF	-4.6	0.0	-1004.6	0.0	1000.	270.	AG	1361.	24.5	0.0	15.1		
3. FOSTER ST. FREE FLOW	-4.6	0.0	-4.6	1000.0	1000.	360.	AG	781.	28.7	0.0	15.1		
4. FOSTER ST. RT QUEUE	-6.5	9.1	-6.5	21.7	13.	360.	AG	1282.	100.0	0.0	4.6	0.68	2.1

JOB: COMMONWEALTH AVENUE/FOSTER STREET RUN: 1994 BUILD PRE-GAME ONE-HOUR
DATE: 11/22/93
TIME: 10:09:38

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	APPROACH VOL (VPH)	CAPACITY (VPH)	IDLE EM FAC (gm/hr)
4. FOSTER ST. RT QUEUE	398	588.	478.10

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. #2301(A) COMM AVE	-16.8	13.0	1.8
2. #2301(B) COMM AVE	-16.8	23.6	1.8
3. #315 FOSTER STREET	-16.8	35.1	1.8
4. #292 FOSTER STREET	7.6	35.1	1.8
5. #2025(B) COMM AVE	6.1	21.3	1.8
6. #2025(B) COMM AVE	13.0	12.2	1.8

JOB: COMMONWEALTH AVENUE/FOSTER STREET RUN: 1994 BUILD PRE-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6
0.	*	3.6	3.6	3.6	3.6	3.7	3.4
10.	*	3.8	3.8	3.8	3.2	3.3	3.1
20.	*	3.9	3.7	3.7	3.0	3.0	3.0
30.	*	4.1	3.7	3.7	2.9	2.9	2.9
40.	*	4.5	3.6	3.6	2.9	2.9	2.9
50.	*	4.8	3.5	3.5	2.9	2.9	2.9
60.	*	5.3	3.5	3.5	2.9	2.9	2.9
70.	*	5.7	3.6	3.5	2.9	3.0	3.1
80.	*	6.2	4.0	3.6	3.0	3.2	3.4
90.	*	6.4	4.8	3.9	3.3	3.5	3.9
100.	*	6.4	5.5	4.1	3.5	3.7	4.2
110.	*	5.8	5.8	4.2	3.5	3.7	4.1
120.	*	5.3	6.0	4.3	3.4	3.6	4.0
130.	*	4.6	6.1	4.6	3.4	3.6	3.9
140.	*	4.3	5.7	4.8	3.4	3.5	3.8
150.	*	4.1	5.2	5.0	3.3	3.5	3.8
160.	*	3.9	4.5	4.8	3.3	3.5	3.7
170.	*	3.8	4.0	4.3	3.4	3.6	3.7
180.	*	3.7	3.6	3.8	3.6	3.7	3.8
190.	*	3.7	3.5	3.5	3.9	3.8	3.7
200.	*	3.7	3.5	3.3	4.4	4.1	3.7
210.	*	3.8	3.5	3.3	4.8	4.5	3.9
220.	*	3.8	3.5	3.4	4.8	5.1	4.0
230.	*	3.9	3.5	3.4	4.7	5.5	4.3
240.	*	4.0	3.6	3.4	4.4	5.8	4.5
250.	*	4.1	3.7	3.5	4.3	6.0	5.0
260.	*	4.1	3.7	3.5	4.1	5.8	5.4
270.	*	3.8	3.5	3.3	3.9	5.2	5.4
280.	*	3.4	3.1	3.0	3.6	4.5	5.0
290.	*	3.0	2.9	2.9	3.5	4.0	4.5
300.	*	2.9	2.9	2.9	3.5	3.6	4.1
310.	*	2.9	2.9	2.9	3.5	3.6	3.8
320.	*	2.9	2.9	2.9	3.6	3.6	3.5
330.	*	2.9	2.9	2.9	3.7	3.7	3.5
340.	*	3.0	3.0	3.0	3.7	3.8	3.5
350.	*	3.2	3.2	3.2	3.8	3.9	3.5
360.	*	3.6	3.6	3.6	3.6	3.7	3.4
MAX	*	6.4	6.1	5.0	4.8	6.0	5.4
DEGR.	*	100	130	150	210	250	260

THE HIGHEST CONCENTRATION IS 6.40 PPM AT 100 DEGREES FROM REC1 .

JOB: COMMONWEALTH AVENUE/SOUTH STREET RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 11:24:52

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 3.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST EB FF	0.0	-13.0	1000.0	-13.0	1000.	90.	AG	911.	25.6	0.0	12.1		
2. COMM AVE EAST WB FF	0.0	1.5	1000.0	1.5	1000.	90.	AG	915.	25.6	0.0	12.1		
3. COMM AVE WEST EB FF	0.0	-13.0	-1000.0	-13.0	1000.	270.	AG	977.	25.6	0.0	12.1		
4. COMM AVE WEST WB FF	0.0	1.5	-1000.0	1.5	1000.	270.	AG	1054.	25.6	0.0	12.1		
5. SOUTH ST. FREE FLOW	-13.0	2.3	796.0	590.0	1000.	54.	AG	205.	29.7	0.0	10.6		
6. COMM AVE EB QUEUE	-11.4	-13.0	-48.8	-13.0	37.	270.	AG	1433.	100.0	0.0	6.7	0.70	6.2
7. COMM AVE WB QUEUE	10.7	1.5	45.7	1.5	35.	90.	AG	1433.	100.0	0.0	6.7	0.65	5.8
8. SOUTH STREET QUEUE	-2.3	10.7	10.1	19.7	15.	54.	AG	1028.	100.0	0.0	4.6	0.41	2.5

JOB: COMMONWEALTH AVENUE/SOUTH STREET RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 11:24:52

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION		CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
6. COMM AVE EB	QUEUE	89	46	2.0	977	1600	516.80	3	3
7. COMM AVE WB	QUEUE	89	46	2.0	915	1600	516.80	3	3
8. SOUTH STREET	QUEUE	89	66	2.0	139	1600	516.80	3	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. #2000 COMM AVE	-34.3	-24.4	1.8
2. RESERVOIR GARDENS	-13.0	-25.1	1.8
3. #1982 COMM AVE	19.8	-25.1	1.8
4. #1997 COMM AVE	-22.9	15.2	1.8
5. #43 SOUTH STREET	-5.3	16.8	1.8
6. #41 SOUTH STREET	0.8	21.3	1.8
7. #39 SOUTH STREET	3.8	23.6	1.8
8. #1963(A) COMM AVE	26.7	15.2	1.8
9. #1963(A) COMM AVE	17.5	17.5	1.8
10. #1963(A) COMM AVE	26.7	24.4	1.8
11. #1961 COMM AVE	30.5	15.2	1.8

JOB: COMMONWEALTH AVENUE/SOUTH STREET RUN: 1993 EXISTING POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8	REC9	REC10	REC11
0.	6.9	6.1	5.7	3.0	3.0	3.0	3.0	3.1	3.2	3.2	3.1
10.	6.9	5.6	5.7	3.0	3.0	3.0	3.0	3.2	3.2	3.2	3.1
20.	7.0	5.5	5.6	3.0	3.0	3.0	3.0	3.2	3.3	3.3	3.1
30.	7.2	5.2	5.6	3.0	3.0	3.0	3.0	3.2	3.3	3.3	3.2
40.	7.5	5.2	5.2	3.0	3.2	3.1	3.1	3.2	3.4	3.4	3.2
50.	7.9	5.4	4.9	3.1	3.4	3.2	3.2	3.2	3.4	3.4	3.2
60.	7.4	5.3	4.4	3.4	3.9	3.4	3.3	3.1	3.3	3.3	3.1
70.	6.6	5.1	4.4	3.8	4.5	3.5	3.3	3.1	3.2	3.1	3.1
80.	5.4	4.7	4.3	4.6	5.6	4.1	3.7	3.4	3.4	3.4	3.4
90.	4.5	4.0	3.9	5.4	6.7	5.0	4.1	4.0	3.9	3.6	3.9
100.	3.7	3.4	3.4	5.9	7.9	6.2	4.8	4.3	4.5	3.9	4.2
110.	3.1	3.1	3.1	5.8	8.4	7.1	5.6	4.8	4.9	4.0	4.5
120.	3.0	3.0	3.0	5.2	8.3	7.8	6.4	5.3	5.5	4.1	4.9
130.	3.0	3.0	3.0	4.8	7.6	8.1	7.2	5.8	6.0	4.3	5.4
140.	3.0	3.0	3.0	4.5	6.7	7.9	7.5	6.2	6.1	4.7	5.9
150.	3.0	3.0	3.0	4.5	5.9	7.5	7.6	6.2	6.2	5.1	6.1
160.	3.0	3.0	3.0	4.8	5.2	7.1	7.3	6.4	6.1	5.4	6.3
170.	3.0	3.0	3.0	5.2	4.8	6.6	6.8	6.4	6.1	5.5	6.4
180.	3.0	3.0	3.0	5.5	4.8	6.3	6.6	6.4	5.9	5.6	6.4
190.	3.0	3.0	3.0	5.6	4.8	6.0	6.5	6.4	5.6	5.5	6.4
200.	3.0	3.0	3.0	5.4	5.1	6.0	6.3	6.3	5.3	5.4	6.4
210.	3.0	3.0	3.0	5.4	5.4	5.8	6.1	6.3	5.1	5.3	6.5
220.	3.0	3.0	3.0	5.1	5.5	5.5	5.8	6.3	5.4	5.4	6.4
230.	3.0	3.0	3.0	4.7	5.4	5.1	5.3	6.3	5.8	5.8	6.4
240.	3.0	3.0	3.0	4.5	4.9	4.8	4.8	6.2	6.5	5.7	6.4
250.	3.1	3.1	3.2	4.4	4.6	4.3	4.3	6.0	6.8	5.7	6.1
260.	3.6	3.7	3.9	4.4	4.3	4.2	4.1	5.8	6.7	5.3	6.0
270.	4.2	4.7	4.8	4.0	3.9	3.8	3.7	5.3	6.2	4.6	5.2
280.	4.6	5.7	5.5	3.4	3.4	3.3	3.3	4.4	5.2	3.7	4.2
290.	5.0	6.4	5.5	3.1	3.1	3.0	3.0	3.8	4.4	3.3	3.7
300.	5.5	7.0	5.0	3.0	3.0	3.0	3.0	3.5	3.9	3.2	3.3
310.	6.0	7.1	4.6	3.0	3.0	3.0	3.0	3.2	3.6	3.2	3.2
320.	6.5	7.0	4.5	3.0	3.0	3.0	3.0	3.1	3.3	3.2	3.1
330.	6.7	6.8	4.8	3.0	3.0	3.0	3.0	3.1	3.2	3.2	3.1
340.	6.9	6.6	5.3	3.0	3.0	3.0	3.0	3.1	3.2	3.2	3.1
350.	6.9	6.4	5.5	3.0	3.0	3.0	3.0	3.1	3.2	3.2	3.1
360.	6.9	6.1	5.7	3.0	3.0	3.0	3.0	3.1	3.2	3.2	3.1
MAX	7.9	7.1	5.7	5.9	8.4	8.1	7.6	6.4	6.8	5.8	6.5
DEGR.	50	310	0	100	110	130	150	160	250	230	210

THE HIGHEST CONCENTRATION IS 8.40 PPM AT 110 DEGREES FROM REC5 .

JOB: COMMONWEALTH AVENUE/SOUTH STREET RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 11:28:55

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 2.9 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST EB FF	0.0	-13.0	1000.0	-13.0	1000.	90.	AG	944.	24.5	0.0	12.1		
2. COMM AVE EAST WB FF	0.0	1.5	1000.0	1.5	1000.	90.	AG	920.	24.5	0.0	12.1		
3. COMM AVE WEST EB FF	0.0	-13.0	-1000.0	-13.0	1000.	270.	AG	1014.	24.5	0.0	12.1		
4. COMM AVE WEST WB FF	0.0	1.5	-1000.0	1.5	1000.	270.	AG	1054.	24.5	0.0	12.1		
5. SOUTH ST. FREE FLOW	-13.0	2.3	796.0	590.0	1000.	54.	AG	204.	28.7	0.0	10.6		
6. COMM AVE EB QUEUE	-11.4	-13.0	-44.4	-13.0	33.	270.	AG	1124.	100.0	0.0	6.7	0.61	5.5
7. COMM AVE WB QUEUE	10.7	1.5	40.6	1.5	30.	90.	AG	1124.	100.0	0.0	6.7	0.56	5.0
8. SOUTH STREET QUEUE	-2.3	10.7	11.2	20.5	17.	54.	AG	1052.	100.0	0.0	4.6	0.62	2.8

JOB: COMMONWEALTH AVENUE/SOUTH STREET RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 11:28:55

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
6. COMM AVE EB QUEUE	*	89	39	2.0	1014	1600	478.10	3	3
7. COMM AVE WB QUEUE	*	89	39	2.0	920	1600	478.10	3	3
8. SOUTH STREET QUEUE	*	89	73	2.0	134	1600	478.10	3	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (M) X	Y	Z	*
1. #2000 COMM AVE	*	-34.3	-24.4	1.8	*
2. RESERVOIR GARDENS	*	-13.0	-25.1	1.8	*
3. #1982 COMM AVE	*	19.8	-25.1	1.8	*
4. #1997 COMM AVE	*	-22.9	15.2	1.8	*
5. #43 SOUTH STREET	*	-5.3	16.8	1.8	*
6. #41 SOUTH STREET	*	0.8	21.3	1.8	*
7. #39 SOUTH STREET	*	3.8	23.6	1.8	*
8. #1963(A) COMM AVE	*	26.7	15.2	1.8	*
9. #1963(A) COMM AVE	*	17.5	17.5	1.8	*
10. #1963(A) COMM AVE	*	26.7	24.4	1.8	*
11. #1961 COMM AVE	*	30.5	15.2	1.8	*

JOB: COMMONWEALTH AVENUE/SOUTH STREET RUN: 1994 BUILD POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8	REC9	REC10	REC11
0.	*	6.2	5.5	5.3	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.0
10.	*	6.2	5.3	5.2	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.0
20.	*	6.3	5.1	5.1	2.9	2.9	2.9	2.9	3.1	3.2	3.2	3.0
30.	*	6.5	5.0	4.9	2.9	2.9	2.9	2.9	3.1	3.2	3.2	3.1
40.	*	6.7	5.0	4.7	2.9	3.1	3.0	3.0	3.1	3.3	3.3	3.1
50.	*	7.0	4.8	4.5	3.0	3.4	3.1	3.1	3.1	3.3	3.3	3.0
60.	*	6.7	4.9	4.1	3.2	3.9	3.3	3.2	3.0	3.2	3.2	3.0
70.	*	6.0	4.6	4.1	3.7	4.6	3.6	3.2	3.0	3.1	3.0	3.0
80.	*	5.1	4.3	4.1	4.3	5.5	4.3	3.7	3.3	3.3	3.3	3.3
90.	*	4.3	3.9	3.8	5.1	6.6	5.2	4.1	3.8	3.7	3.5	3.8
100.	*	3.4	3.3	3.3	5.5	7.5	6.0	5.0	4.1	4.1	3.7	4.0
110.	*	3.0	3.0	3.0	5.4	7.8	6.8	5.7	4.2	4.4	3.8	4.1
120.	*	2.9	2.9	2.9	4.9	7.8	7.3	6.4	4.4	4.8	3.7	4.1
130.	*	2.9	2.9	2.9	4.6	7.3	7.6	7.0	4.9	5.1	3.8	4.5
140.	*	2.9	2.9	2.9	4.4	6.4	7.5	7.3	5.1	5.3	4.1	4.7
150.	*	2.9	2.9	2.9	4.3	5.7	7.3	7.4	5.4	5.5	4.4	5.1
160.	*	2.9	2.9	2.9	4.5	5.1	6.7	7.1	5.6	5.5	4.7	5.4
170.	*	2.9	2.9	2.9	4.8	4.8	6.4	6.7	5.7	5.5	4.9	5.6
180.	*	2.9	2.9	2.9	5.0	4.6	6.1	6.5	5.7	5.4	5.0	5.7
190.	*	2.9	2.9	2.9	5.1	4.6	5.9	6.3	5.7	5.1	5.0	5.7
200.	*	2.9	2.9	2.9	4.9	4.7	5.8	6.2	5.7	4.8	4.9	5.7
210.	*	2.9	2.9	2.9	4.8	4.9	5.4	5.9	5.7	4.7	4.9	5.8
220.	*	2.9	2.9	2.9	4.5	5.0	5.1	5.4	5.8	5.0	5.0	5.7
230.	*	2.9	2.9	2.9	4.3	4.8	4.6	4.9	5.8	5.4	5.4	5.8
240.	*	2.9	2.9	2.9	4.1	4.5	4.3	4.4	5.7	6.1	5.5	5.8
250.	*	3.0	3.0	3.1	4.2	4.2	4.1	4.1	5.7	6.6	5.7	5.7
260.	*	3.5	3.4	3.6	4.2	4.2	3.9	3.9	5.6	6.8	5.1	5.5
270.	*	4.0	4.4	4.5	3.8	3.8	3.7	3.6	5.2	6.4	4.5	5.1
280.	*	4.3	5.1	5.1	3.3	3.3	3.2	3.2	4.4	5.6	3.7	4.2
290.	*	4.5	5.6	5.0	3.0	3.0	2.9	2.9	3.9	4.8	3.2	3.7
300.	*	4.7	6.1	4.7	2.9	2.9	2.9	2.9	3.5	4.2	3.1	3.3
310.	*	4.9	6.2	4.4	2.9	2.9	2.9	2.9	3.2	3.8	3.1	3.1
320.	*	5.4	6.2	4.3	2.9	2.9	2.9	2.9	3.1	3.4	3.1	3.0
330.	*	5.7	6.1	4.7	2.9	2.9	2.9	2.9	3.0	3.2	3.1	3.0
340.	*	5.9	5.9	4.9	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.0
350.	*	6.1	5.8	5.1	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.0
360.	*	6.2	5.5	5.3	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.0
MAX	*	7.0	6.2	5.3	5.5	7.8	7.6	7.4	5.8	6.8	5.7	5.8
DEGR.	*	50	310	0	100	110	130	150	220	260	250	210

THE HIGHEST CONCENTRATION IS 7.80 PPM AT 110 DEGREES FROM REC5 .

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL DR. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 14:55:38

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 3.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST EB FF	0.0	-10.7	1000.0	-10.7	1000.	90.	AG	708.	25.6	0.0	15.1		
2. COMM AVE EAST WB FF	0.0	4.6	1000.0	4.6	1000.	90.	AG	985.	25.6	0.0	12.1		
3. COMM AVE WEST EB FF	0.0	-9.1	-1000.0	-9.1	1000.	270.	AG	682.	25.6	0.0	12.1		
4. COMM AVE WEST WB FF	0.0	4.6	-1000.0	4.6	1000.	270.	AG	946.	25.6	0.0	12.1		
5. CNUT HILL DR. FR FLO	0.0	0.0	-207.9	-978.3	1000.	192.	AG	163.	44.6	0.0	17.4		
6. COMM AVE EB QUEUE	-18.3	-9.1	-47.8	-9.1	30.	270.	AG	1584.	100.0	0.0	6.4	0.55	4.9
7. COMM AVE WB QUEUE	10.7	4.6	55.8	4.6	45.	90.	AG	1584.	100.0	0.0	6.4	0.80	7.5
8. CHNUT HILL DR. QUEUE	3.0	-16.8	1.0	-26.6	10.	192.	AG	1036.	100.0	0.0	4.6	0.27	1.7

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL DR. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 14:55:38

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
6. COMM AVE EB QUEUE	*	91	52	2.0	682	1600	516.80	3	3
7. COMM AVE WB QUEUE	*	91	52	2.0	985	1600	516.80	3	3
8. CHNUT HILL DR. QUEUE	*	91	68	2.0	89	1600	516.80	3	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (M) X	Y	Z	*
1. RESERVOIR TOWERS (A)	*	-19.8	19.8	1.8	*
2. RESERVOIR TOWERS (B)	*	-10.7	19.8	1.8	*
3. #1940(A) COMM AVE	*	-45.7	-19.8	1.8	*
4. #1940(B) COMM AVE	*	-36.6	-45.7	1.8	*

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL DR.   RUN: 1993 EXISTING POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) REC1	REC2	REC3	REC4
0.	3.0	3.0	6.3	4.6
10.	3.0	3.0	6.8	4.6
20.	3.0	3.0	7.0	4.5
30.	3.0	3.0	7.2	4.5
40.	3.0	3.0	7.4	4.4
50.	3.0	3.0	7.5	4.6
60.	3.0	3.0	7.6	4.4
70.	3.2	3.2	7.5	4.3
80.	3.7	3.7	6.6	3.9
90.	4.6	4.6	5.3	3.5
100.	5.3	5.5	4.1	3.3
110.	5.4	5.9	3.3	3.1
120.	5.0	5.7	3.2	3.1
130.	4.5	5.2	3.1	3.1
140.	4.3	4.4	3.1	3.1
150.	4.4	4.3	3.1	3.1
160.	4.4	4.2	3.1	3.1
170.	4.6	4.4	3.1	3.2
180.	4.9	4.4	3.1	3.2
190.	5.1	4.7	3.1	3.1
200.	5.3	4.8	3.0	3.1
210.	5.2	5.1	3.0	3.0
220.	5.0	5.2	3.0	3.0
230.	4.6	5.0	3.0	3.0
240.	4.2	4.6	3.0	3.0
250.	4.1	4.3	3.1	3.0
260.	4.0	4.1	3.5	3.2
270.	3.8	3.8	3.9	3.4
280.	3.4	3.4	4.2	3.6
290.	3.1	3.1	4.2	3.6
300.	3.0	3.0	4.1	3.6
310.	3.0	3.0	4.0	3.5
320.	3.0	3.0	4.1	3.5
330.	3.0	3.0	4.5	3.7
340.	3.0	3.0	5.0	4.1
350.	3.0	3.0	5.6	4.4
360.	3.0	3.0	6.3	4.6
MAX	5.4	5.9	7.6	4.6
DEGR.	110	110	60	50

THE HIGHEST CONCENTRATION IS 7.60 PPM AT 60 DEGREES FROM REC3 .

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL DR. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 14:58:14

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 2.9 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST EB FF	0.0	-10.7	1000.0	-10.7	1000.	90.	AG	712.	24.5	0.0	15.1		
2. COMM AVE EAST WB FF	0.0	4.6	1000.0	4.6	1000.	90.	AG	1025.	24.5	0.0	12.1		
3. COMM AVE WEST EB FF	0.0	-9.1	-1000.0	-9.1	1000.	270.	AG	683.	24.5	0.0	12.1		
4. COMM AVE WEST WB FF	0.0	4.6	-1000.0	4.6	1000.	270.	AG	986.	24.5	0.0	12.1		
5. CNUT HILL DR. FR FLO	0.0	0.0	-207.9	-978.3	1000.	192.	AG	166.	43.1	0.0	17.4		
6. COMM AVE EB QUEUE	-18.3	-9.1	-47.8	-9.1	30.	270.	AG	1466.	100.0	0.0	6.4	0.55	4.9
7. COMM AVE WB QUEUE	10.7	4.6	59.7	4.6	49.	90.	AG	1466.	100.0	0.0	6.4	0.83	8.2
8. CHNUT HILL DR. QUEUE	3.0	-16.8	0.9	-27.0	10.	192.	AG	958.	100.0	0.0	4.6	0.28	1.7

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL DR. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/22/93
TIME: 14:58:14

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
6. COMM AVE EB QUEUE	91	52	2.0	683	1600	478.10	3	3
7. COMM AVE WB QUEUE	91	52	2.0	1025	1600	478.10	3	3
8. CHNUT HILL DR. QUEUE	91	68	2.0	92	1600	478.10	3	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. RESERVOIR TOWERS (A)	-19.8	19.8	1.8
2. RESERVOIR TOWERS (B)	-10.7	19.8	1.8
3. #1940(A) COMM AVE	-45.7	-19.8	1.8
4. #1940(B) COMM AVE	-36.6	-45.7	1.8

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL DR.   RUN: 1994 BUILD   POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) REC1	REC2	REC3	REC4
0.	2.9	2.9	5.9	4.5
10.	2.9	2.9	6.4	4.4
20.	2.9	2.9	6.6	4.3
30.	2.9	2.9	6.8	4.2
40.	2.9	2.9	7.0	4.2
50.	2.9	2.9	7.2	4.4
60.	2.9	2.9	7.2	4.3
70.	3.1	3.1	7.1	4.2
80.	3.6	3.6	6.4	3.8
90.	4.5	4.5	5.1	3.4
100.	5.2	5.4	3.9	3.2
110.	5.3	5.7	3.2	3.0
120.	4.8	5.5	3.0	3.0
130.	4.4	4.9	3.0	3.0
140.	4.2	4.2	3.0	3.0
150.	4.1	4.2	3.0	3.0
160.	4.2	3.9	3.0	3.0
170.	4.4	4.3	3.0	3.1
180.	4.7	4.2	3.0	3.1
190.	4.9	4.5	3.0	3.0
200.	5.1	4.7	2.9	3.0
210.	5.0	4.9	2.9	2.9
220.	4.7	4.9	2.9	2.9
230.	4.5	4.8	2.9	2.9
240.	4.1	4.4	2.9	2.9
250.	4.0	4.2	3.0	2.9
260.	3.9	4.0	3.4	3.1
270.	3.7	3.7	3.8	3.3
280.	3.3	3.3	4.1	3.5
290.	3.0	3.0	4.0	3.5
300.	2.9	2.9	4.0	3.4
310.	2.9	2.9	3.9	3.4
320.	2.9	2.9	4.0	3.4
330.	2.9	2.9	4.3	3.6
340.	2.9	2.9	4.7	3.9
350.	2.9	2.9	5.3	4.2
360.	2.9	2.9	5.9	4.5
MAX	5.3	5.7	7.2	4.5
DEGR.	110	110	50	0

THE HIGHEST CONCENTRATION IS 7.20 PPM AT 50 DEGREES FROM REC3 .

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL AVE. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 15:43:11

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 3.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1 (M)	Y1 (M)	X2 (M)	Y2 (M)	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST FRE FL	-12.2	0.0	532.5	838.7	1000.	33.	AG	1609.	25.6	0.0	40.2		
2. COMM AVE WEST FRE FL	0.0	0.0	-933.6	358.4	1000.	291.	AG	2336.	25.6	0.0	32.9		
3. CNUT HILL AVE NOR FF	0.0	0.0	-642.8	766.1	1000.	320.	AG	1824.	29.7	0.0	13.6		
4. CNUT HILL AVE SOU FF	0.0	0.0	642.8	-766.1	1000.	140.	AG	1807.	44.6	0.0	20.6		
5. COMM AVE. EB THR QUE	-39.6	1.5	-1080.0	400.8	1114.	291.	AG	1088.	100.0	0.0	3.7	2.08	185.7
6. COMM AVE. WB T/R QUE	18.3	25.9	178.2	272.1	294.	33.	AG	2346.	100.0	0.0	7.3	1.37	48.9
7. CNUT HIL AV NB T/R Q	8.2	-2.4	33.2	-32.2	39.	140.	AG	544.	100.0	0.0	3.7	0.50	6.5
8. CHNUT HILL AVE SB QU	-36.6	41.1	-753.7	895.7	1116.	320.	AG	768.	100.0	0.0	3.7	1.47	185.9
9. COMM AVE EB LT QUEUE	-39.6	6.1	-115.2	35.1	81.	291.	AG	1056.	100.0	0.0	3.7	1.00	13.5
10. COMM AVE WB LT QUEUE	15.2	30.5	34.5	60.1	35.	33.	AG	1141.	100.0	0.0	3.7	0.78	5.9
11. CNUT HIL AV NB LT QU	4.6	-4.6	55.4	-65.2	79.	140.	AG	1162.	100.0	0.0	3.7	1.03	13.2
12. COMM AVE. EB RGT QUE	-39.6	-1.5	-105.7	23.9	71.	291.	AG	864.	100.0	0.0	3.7	0.86	11.8

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL AVE. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 15:43:11

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
5. COMM AVE. EB THR QUE*	130	102	2.0	614	1600	516.80	3	3
6. COMM AVE. WB T/R QUE*	130	110	2.0	536	1600	516.80	3	3
7. CNUT HIL AV NB T/R Q*	130	51	2.0	457	1600	516.80	3	3
8. CHNUT HILL AVE SB QU*	130	72	2.0	978	1600	516.80	3	3
9. COMM AVE EB LT QUEUE*	130	99	2.0	331	1600	516.80	3	3
10. COMM AVE WB LT QUEUE*	130	107	2.0	181	1600	516.80	3	3
11. CNUT HIL AV NB LT QU*	130	109	2.0	215	1600	516.80	3	3
12. COMM AVE. EB RGT QUE*	130	81	2.0	476	1600	516.80	3	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. RESERVOIR TOWERS	-146.3	91.4	1.8
2. PARK BENCH	-70.1	64.0	1.8
3. #286 CNUT HILL AVE	-53.3	86.9	1.8
4. #288 CNUT HIIL AVE	-41.1	71.6	1.8
5. #1875 COMM AVE	-18.3	48.8	1.8
6. #1871 COMM AVE	-4.6	59.4	1.8
7. #1867 COMM AVE	4.6	77.7	1.8
8. #1880 COMM AVE	25.0	-0.9	1.8
9. #1874 COMM AVE	34.4	7.6	1.8
10. #1870 COMM AVE	53.3	29.0	1.8
11. #324 CNUT HILL AVE	41.1	-27.4	1.8
12. OPEN SPACE #1	-61.0	-6.1	1.8
13. OPEN SPACE #2	9.1	-42.7	1.8

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL AVE. RUN: 1993 EXISTING POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8	REC9	REC10	REC11	REC12	REC13
0.	*	4.2	6.1	3.0	3.0	3.0	3.0	3.0	8.0	8.2	7.2	6.1	9.5	8.3
10.	*	4.1	5.9	3.0	3.0	3.0	3.1	3.1	8.7	8.2	7.3	6.0	9.2	9.5
20.	*	4.0	5.7	3.0	3.0	3.3	3.5	3.3	8.7	7.8	7.0	5.6	9.3	10.1
30.	*	4.0	5.7	3.2	3.4	4.3	4.6	4.4	7.1	6.4	5.7	4.5	9.9	9.1
40.	*	4.1	6.2	3.6	4.1	5.5	6.1	5.7	4.9	4.5	4.2	3.5	10.9	7.6
50.	*	4.4	6.9	4.2	4.8	6.5	7.0	6.6	3.5	3.4	3.3	3.0	11.2	6.8
60.	*	4.8	7.2	4.6	5.1	6.7	6.9	6.7	3.0	3.0	3.0	3.0	10.6	6.4
70.	*	5.0	7.4	4.8	5.2	6.7	6.8	6.5	3.0	3.0	3.0	3.0	8.8	6.2
80.	*	5.1	7.6	4.8	5.2	6.6	6.8	6.4	3.0	3.0	3.0	3.0	7.4	6.1
90.	*	5.1	7.7	4.8	5.1	6.7	6.7	6.1	3.0	3.0	3.0	3.0	6.0	6.2
100.	*	5.2	7.8	4.9	5.3	6.4	6.9	6.2	3.0	3.0	3.0	3.1	5.5	6.2
110.	*	5.4	7.6	4.9	5.2	5.9	7.0	6.2	3.0	3.0	3.0	3.1	4.8	6.1
120.	*	6.2	7.6	5.1	5.2	5.6	7.0	6.5	3.2	3.1	3.0	3.4	4.6	5.9
130.	*	6.7	7.6	5.5	5.5	5.8	6.9	6.9	3.9	3.4	3.2	4.4	4.3	5.5
140.	*	6.6	7.3	6.2	6.4	6.6	7.2	7.3	5.3	4.2	3.6	5.9	3.7	4.8
150.	*	5.8	6.4	6.7	6.7	7.3	7.1	7.8	6.5	4.8	3.9	7.0	3.2	3.7
160.	*	5.2	5.9	6.8	6.6	7.0	6.7	7.5	7.2	5.2	4.1	7.4	3.0	3.2
170.	*	4.9	5.9	7.0	6.6	6.1	6.2	6.9	7.3	5.4	4.1	7.4	3.0	3.0
180.	*	4.8	5.9	7.1	6.8	5.7	5.6	5.8	7.4	5.7	4.3	7.3	3.0	3.0
190.	*	4.7	6.0	7.3	7.3	5.8	5.2	5.3	7.2	5.8	4.5	7.1	3.0	3.0
200.	*	4.8	6.0	7.2	7.6	5.9	5.3	5.0	7.1	5.9	4.7	6.9	3.0	3.0
210.	*	4.7	5.8	7.1	7.5	6.2	5.4	5.0	6.9	5.8	4.7	6.7	3.0	3.0
220.	*	4.7	5.7	7.0	7.5	6.6	5.7	5.3	6.9	5.8	4.8	6.9	3.0	3.0
230.	*	4.8	5.5	6.8	7.3	7.0	6.2	5.6	7.2	5.8	4.7	7.1	3.0	3.0
240.	*	4.9	5.3	6.6	7.2	7.2	6.3	5.7	6.9	5.8	5.1	7.2	3.0	3.0
250.	*	5.0	5.2	6.5	7.0	7.5	6.5	5.5	7.2	6.1	6.2	7.4	3.0	3.0
260.	*	5.2	5.2	6.6	7.0	7.5	6.3	5.3	7.8	6.6	7.7	8.0	3.0	3.0
270.	*	5.4	5.2	7.0	7.1	7.6	6.2	5.4	8.5	7.6	8.7	8.9	3.3	3.1
280.	*	5.4	5.3	7.0	7.3	7.5	6.1	5.5	9.7	8.3	9.6	10.7	4.4	4.0
290.	*	4.6	4.6	6.7	7.0	7.1	5.6	5.0	9.7	7.9	9.5	11.9	6.3	5.4
300.	*	3.7	4.1	6.2	6.6	6.3	5.2	4.6	8.1	7.1	8.9	11.5	8.3	6.5
310.	*	3.3	4.7	6.2	6.2	5.9	4.8	4.3	7.0	7.1	8.4	9.9	9.4	7.0
320.	*	3.8	6.1	5.5	5.5	5.2	4.2	3.8	6.1	7.2	7.8	7.6	10.1	7.0
330.	*	4.3	6.8	4.1	4.2	4.0	3.4	3.2	5.7	7.5	7.2	6.1	10.4	6.9
340.	*	4.4	6.7	3.2	3.3	3.2	3.0	3.0	5.8	7.6	6.9	5.5	10.2	6.6
350.	*	4.2	6.3	3.0	3.0	3.0	3.0	3.0	6.8	8.2	7.0	5.8	9.7	7.2
360.	*	4.2	6.1	3.0	3.0	3.0	3.0	3.0	8.0	8.2	7.2	6.1	9.5	8.3
MAX	*	6.7	7.8	7.3	7.6	7.6	7.2	7.8	9.7	8.3	9.6	11.9	11.2	10.1
DEGR.	*	130	100	190	200	270	140	150	290	280	280	290	50	20

THE HIGHEST CONCENTRATION IS 11.90 PPM AT 290 DEGREES FROM REC11.

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL AVE. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 16:06:35

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 2.9 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. COMM AVE EAST FRE FL	-12.2	0.0	532.5	838.7	1000.	33.	AG	1657.	24.5	0.0	40.2		
2. COMM AVE WEST FRE FL	0.0	0.0	-933.6	358.4	1000.	291.	AG	2444.	24.5	0.0	32.9		
3. CNUT HILL AVE NOR FF	0.0	0.0	-642.8	766.1	1000.	320.	AG	1858.	28.7	0.0	13.6		
4. CNUT HILL AVE SOU FF	0.0	0.0	642.8	-766.1	1000.	140.	AG	1859.	43.1	0.0	20.6		
5. COMM AVE. EB THR QUE	-39.6	1.5	-1181.0	439.8	1223.	291.	AG	996.	100.0	0.0	3.7	2.15	203.8
6. COMM AVE. WB T/R QUE	18.3	25.9	178.2	272.1	294.	33.	AG	2170.	100.0	0.0	7.3	1.37	48.9
7. CNUT HIL AV NB T/R Q	8.2	-2.4	34.4	-33.6	41.	140.	AG	513.	100.0	0.0	3.7	0.52	6.8
8. CHNUT HILL AVE SB QU	-36.6	41.1	-755.8	898.1	1119.	320.	AG	710.	100.0	0.0	3.7	1.47	186.5
9. COMM AVE EB LT QUEUE	-39.6	6.1	-148.0	47.7	116.	291.	AG	967.	100.0	0.0	3.7	1.03	19.3
10. COMM AVE WB LT QUEUE	15.2	30.5	34.5	60.1	35.	33.	AG	1056.	100.0	0.0	3.7	0.78	5.9
11. CNUT HIL AV NB LT QU	4.6	-4.6	89.7	-106.0	132.	140.	AG	1085.	100.0	0.0	3.7	1.12	22.1
12. COMM AVE. EB RGT QUE	-39.6	-1.5	-118.2	28.6	84.	291.	AG	799.	100.0	0.0	3.7	0.92	14.0

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL AVE. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 16:06:35

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
5. COMM AVE. EB THR QUE	*	130	101	2.0	659	1600	478.10	3	3
6. COMM AVE. WB T/R QUE	*	130	110	2.0	536	1600	478.10	3	3
7. CNUT HIL AV NB T/R Q	*	130	52	2.0	470	1600	478.10	3	3
8. CHNUT HILL AVE SB QU	*	130	72	2.0	979	1600	478.10	3	3
9. COMM AVE EB LT QUEUE	*	130	98	2.0	354	1600	478.10	3	3
10. COMM AVE WB LT QUEUE	*	130	107	2.0	181	1600	478.10	3	3
11. CNUT HIL AV NB LT QU	*	130	110	2.0	219	1600	478.10	3	3
12. COMM AVE. EB RGT QUE	*	130	81	2.0	511	1600	478.10	3	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (M) X	Y	Z	*
1. RESERVOIR TOWERS	*	-146.3	91.4	1.8	*
2. PARK BENCH	*	-70.1	64.0	1.8	*
3. #286 CNUT HILL AVE	*	-53.3	86.9	1.8	*
4. #288 CNUT HIIL AVE	*	-41.1	71.6	1.8	*
5. #1875 COMM AVE	*	-18.3	48.8	1.8	*
6. #1871 COMM AVE	*	-4.6	59.4	1.8	*
7. #1867 COMM AVE	*	4.6	77.7	1.8	*
8. #1880 COMM AVE	*	25.0	-0.9	1.8	*
9. #1874 COMM AVE	*	34.4	7.6	1.8	*
10. #1870 COMM AVE	*	53.3	29.0	1.8	*
11. #324 CNUT HILL AVE	*	41.1	-27.4	1.8	*
12. OPEN SPACE #1	*	-61.0	-6.1	1.8	*
13. OPEN SPACE #2	*	9.1	-42.7	1.8	*

JOB: COMMONWEALTH AVENUE/CHESTNUT HILL AVE. RUN: 1994 BUILD POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8	REC9	REC10	REC11	REC12	REC13
0.	*	4.0	5.9	2.9	2.9	2.9	2.9	2.9	7.6	7.8	6.7	5.8	9.0	7.9
10.	*	3.9	5.6	2.9	2.9	2.9	3.0	3.0	8.3	7.8	7.0	5.8	8.7	9.1
20.	*	3.9	5.5	2.9	2.9	3.2	3.4	3.2	8.1	7.4	6.7	5.3	8.8	9.6
30.	*	3.8	5.5	3.1	3.2	4.0	4.5	4.2	6.8	6.1	5.5	4.3	9.3	8.8
40.	*	4.0	5.9	3.5	3.8	5.3	5.8	5.5	4.7	4.3	4.0	3.3	10.4	7.3
50.	*	4.3	6.6	4.0	4.5	6.1	6.6	6.4	3.4	3.3	3.2	2.9	10.8	6.6
60.	*	4.7	6.9	4.5	4.9	6.3	6.6	6.4	2.9	2.9	2.9	2.9	10.0	6.1
70.	*	4.8	7.1	4.6	4.9	6.4	6.5	6.2	2.9	2.9	2.9	2.9	8.6	6.1
80.	*	4.9	7.3	4.6	5.0	6.4	6.5	6.1	2.9	2.9	2.9	2.9	7.1	6.0
90.	*	5.0	7.4	4.6	4.9	6.3	6.4	5.9	2.9	2.9	2.9	2.9	5.9	6.1
100.	*	4.9	7.4	4.6	5.0	6.1	6.6	5.8	2.9	2.9	2.9	3.0	5.4	6.2
110.	*	5.3	7.3	4.6	4.9	5.7	6.6	5.9	2.9	2.9	2.9	3.0	4.8	6.4
120.	*	6.0	7.5	4.9	5.0	5.4	6.6	6.2	3.1	3.0	2.9	3.4	4.7	6.3
130.	*	6.7	7.5	5.4	5.5	5.8	6.8	6.5	3.9	3.4	3.1	4.5	4.3	6.0
140.	*	6.8	7.3	6.1	6.3	6.7	7.1	6.9	5.5	4.2	3.5	6.4	3.7	5.0
150.	*	6.2	6.3	6.7	6.7	7.4	7.1	7.7	6.8	5.1	3.9	7.6	3.1	3.7
160.	*	5.7	5.7	6.7	6.5	6.9	6.8	7.4	7.3	5.5	4.2	7.9	2.9	3.1
170.	*	5.3	5.6	6.9	6.4	6.0	6.1	6.7	7.3	5.7	4.3	7.5	2.9	2.9
180.	*	5.0	5.8	7.0	6.5	5.5	5.5	5.7	7.3	5.7	4.4	7.3	2.9	2.9
190.	*	4.8	5.7	7.2	6.9	5.6	5.0	5.2	7.0	5.6	4.5	6.9	2.9	2.9
200.	*	4.7	5.8	7.0	7.1	5.7	5.2	4.9	6.9	5.7	4.6	6.8	2.9	2.9
210.	*	4.6	5.8	7.0	7.2	6.0	5.3	4.8	6.6	5.7	4.5	6.7	2.9	2.9
220.	*	4.6	5.7	6.9	7.1	6.3	5.6	5.1	6.6	5.5	4.6	6.8	2.9	2.9
230.	*	4.6	5.6	6.8	7.2	6.7	5.8	5.3	6.9	5.5	4.6	7.1	2.9	2.9
240.	*	4.7	5.5	6.7	7.0	7.1	6.2	5.6	6.8	5.6	4.9	7.2	2.9	2.9
250.	*	4.8	5.5	6.5	7.0	7.3	6.3	5.5	7.1	5.8	6.0	7.3	2.9	2.9
260.	*	5.0	5.4	6.5	6.9	7.5	6.2	5.5	7.5	6.4	7.3	7.7	2.9	2.9
270.	*	5.2	5.2	6.7	7.0	7.3	6.3	5.3	8.4	7.4	8.5	8.6	3.2	3.0
280.	*	5.2	5.2	6.8	7.1	7.3	6.1	5.2	9.6	8.1	9.3	10.4	4.3	3.8
290.	*	4.5	4.5	6.4	6.7	6.9	5.4	4.9	9.6	7.7	9.1	11.7	6.4	5.2
300.	*	3.6	4.0	6.0	6.4	6.0	5.0	4.3	8.1	7.0	8.5	11.2	8.3	6.6
310.	*	3.2	4.4	5.9	6.0	5.7	4.6	4.1	6.8	6.9	8.1	9.5	9.2	6.8
320.	*	3.7	5.9	5.3	5.3	5.0	4.1	3.7	6.1	6.9	7.4	7.6	9.7	6.8
330.	*	4.1	6.6	4.0	4.0	3.8	3.3	3.1	5.4	7.0	6.8	5.8	9.9	6.8
340.	*	4.2	6.5	3.1	3.2	3.1	2.9	2.9	5.6	7.2	6.6	5.2	9.7	6.4
350.	*	4.1	6.1	2.9	2.9	2.9	2.9	2.9	6.5	7.7	6.6	5.6	9.2	6.9
360.	*	4.0	5.9	2.9	2.9	2.9	2.9	2.9	7.6	7.8	6.7	5.8	9.0	7.9
MAX	*	6.8	7.5	7.2	7.2	7.5	7.1	7.7	9.6	8.1	9.3	11.7	10.8	9.6
DEGR.	*	140	120	190	230	260	140	150	290	280	280	290	50	20

THE HIGHEST CONCENTRATION IS 11.70 PPM AT 290 DEGREES FROM REC11.

JOB: BEACON STREET/CHESTNUT HILL AVENUE RUN: 1993 EXISTING PRE-GAME ONE-HOUR
DATE: 11/19/93
TIME: 12:00:58

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 3.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. BEACON ST EAST WB FF	0.0	9.1	939.7	351.2	1000.	70.	AG	863.	25.6	0.0	17.0		
2. BEACON ST EAST EB FF	42.7	-9.1	982.4	332.9	1000.	70.	AG	572.	25.6	0.0	13.3		
3. BEACON ST WEST FR FL	0.0	9.1	-997.5	-60.6	1000.	266.	AG	1164.	25.6	0.0	20.6		
4. CHSNUT HILL AVE N FF	30.5	-30.5	-612.3	735.6	1000.	320.	AG	1842.	44.6	0.0	20.6		
5. CHSNUT HILL AVE S FF	27.4	-36.6	815.4	-652.2	1000.	128.	AG	1685.	44.6	0.0	20.6		
6. CNUT HILL NB RT FF	33.5	-36.6	67.1	0.0	50.	43.	AG	62.	44.6	0.0	18.2		
7. BEACON ST. EB QUEUE	-33.5	3.0	-71.7	0.4	38.	266.	AG	2079.	100.0	0.0	7.3	0.68	6.4
8. BEACON ST. WB QUEUE	14.6	15.2	40.6	24.7	28.	70.	AG	3336.	100.0	0.0	12.2	0.37	4.6
9. CHNUT HILL AVE SB QU	-22.3	27.4	-57.0	68.8	54.	320.	AG	1430.	100.0	0.0	7.3	0.68	9.0
10. CHNUT HILL AVE NB QU	24.4	-14.6	50.8	-45.5	41.	139.	AG	1430.	100.0	0.0	7.3	0.51	6.8

JOB: BEACON STREET/CHESTNUT HILL AVENUE RUN: 1993 EXISTING PRE-GAME ONE-HOUR
DATE: 11/19/93
TIME: 12:00:58

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
7. BEACON ST. EB QUEUE*	128	96	2.0	478	1600	516.80	3	3
8. BEACON ST. WB QUEUE*	128	77	2.0	863	1600	516.80	3	3
9. CHNUT HILL AVE SB QU*	128	66	2.0	983	1600	516.80	3	3
10. CHNUT HILL AVE NB QU*	128	66	2.0	739	1600	516.80	3	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. RESERVOIR PLACE #1	-36.6	71.6	1.8
2. RESERVOIR PLACE #2	-9.1	48.8	1.8
3. RESERVOIR PLACE #3	7.6	51.8	1.8
4. RESERVOIR PLACE #4	15.2	61.0	1.8
5. RESERVOIR PLACE #5	22.9	81.1	1.8
6. RESIDENCE A	51.8	42.7	1.8
7. RESIDENCE B	65.5	45.7	1.8
8. RESIDENCE C	79.2	50.3	1.8
9. STORE #1	33.5	70.1	1.8
10. STORE #2	33.5	48.8	1.8
11. STORE #3	56.4	39.6	1.8
12. STORE #4	83.8	48.8	1.8
13. STORE #5	53.3	-38.1	1.8
14. DONUT SHOP	65.5	-10.7	1.8
15. RESTAURANT	21.3	-93.0	1.8
16. MOVIE THEATRE	29.0	-108.2	1.8
17. CASSIDY PLAYGROUND	-42.7	-15.2	1.8
18. POOL #1	-59.4	44.2	1.8
19. POOL #2	-87.8	74.7	1.8

JOB: BEACON STREET/CHESTNUT HILL AVENUE RUN: 1993 EXISTING PRE-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8	REC9	REC10	REC11	REC12	REC13	REC14	REC15	REC16	REC17	REC18	REC19
0.	3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	4.1	3.8	5.4	5.3	8.8	5.9	4.8
10.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.7	3.8	5.5	5.1	8.5	6.3	4.7
20.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.1	3.5	3.9	5.3	4.7	7.6	6.6	4.6
30.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.1	3.1	3.4	3.9	4.9	4.2	6.7	6.8	4.6
40.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.1	3.1	3.4	4.0	4.5	4.1	6.2	6.9	4.6
50.	3.0	3.0	3.0	3.0	3.0	3.1	3.1	3.1	3.0	3.0	3.2	3.3	3.6	3.9	4.3	4.1	6.1	7.0	4.6
60.	3.0	3.1	3.1	3.1	3.0	3.3	3.4	3.4	3.1	3.1	3.6	3.7	3.5	4.0	4.1	4.0	6.3	7.1	4.6
70.	3.1	3.3	3.3	3.3	3.2	3.7	3.8	3.9	3.3	3.4	4.1	4.2	3.3	3.8	4.1	4.0	6.3	7.3	4.8
80.	3.3	3.4	3.5	3.4	3.3	4.0	4.1	4.2	3.4	3.7	4.4	4.4	3.1	3.4	3.9	3.8	5.5	7.6	5.1
90.	3.3	3.7	3.5	3.4	3.4	4.0	4.1	4.1	3.4	3.7	4.3	4.3	3.0	3.1	4.0	3.9	4.9	8.1	5.7
100.	3.6	4.1	3.5	3.4	3.3	3.9	4.0	4.0	3.4	3.6	4.1	4.1	3.1	3.0	4.0	3.9	4.7	8.3	6.5
110.	3.9	5.0	3.9	3.4	3.3	3.9	3.9	3.9	3.4	3.5	4.0	4.0	3.4	3.1	4.1	4.0	4.9	8.5	7.5
120.	5.0	6.1	4.8	3.8	3.4	3.9	4.0	4.0	3.5	3.7	4.0	4.0	4.3	3.3	4.0	3.9	4.7	7.9	8.0
130.	6.1	7.1	6.2	4.5	3.7	4.2	4.2	4.1	3.8	4.1	4.3	4.2	5.4	3.8	3.6	3.5	4.1	7.1	7.5
140.	7.1	7.6	7.5	5.7	4.1	4.4	4.4	4.4	3.9	4.7	4.5	4.4	5.9	4.2	3.2	3.1	3.4	5.9	6.1
150.	7.8	7.1	8.1	6.8	4.7	4.5	4.5	4.4	4.4	5.5	4.6	4.5	5.8	4.2	3.0	3.0	3.1	5.1	4.9
160.	8.1	6.4	7.8	7.4	5.5	4.6	4.5	4.4	5.0	6.7	4.6	4.5	5.7	4.1	3.0	3.0	3.0	5.1	4.1
170.	8.6	5.8	7.0	7.2	5.9	4.7	4.5	4.4	5.9	8.2	4.7	4.5	5.8	4.0	3.0	3.0	3.0	5.1	3.8
180.	8.8	5.7	5.7	6.5	5.9	5.1	4.6	4.4	6.5	9.1	4.9	4.4	6.1	4.1	3.0	3.0	3.0	5.0	3.6
190.	8.9	5.6	5.1	5.5	5.4	6.0	4.8	4.6	6.5	9.1	5.4	4.6	6.5	4.2	3.0	3.0	3.0	4.6	3.3
200.	8.7	6.2	4.9	4.7	4.9	6.9	5.2	4.9	6.0	8.5	6.0	4.8	6.9	4.6	3.0	3.0	3.0	4.1	3.3
210.	8.1	7.0	5.0	4.9	4.7	8.2	5.9	5.2	5.1	7.4	7.1	5.1	7.7	5.0	3.0	3.0	3.0	3.7	3.3
220.	7.9	7.6	5.7	5.2	5.0	9.1	6.6	5.8	4.9	6.2	8.2	5.6	8.3	5.3	3.0	3.0	3.0	3.5	3.3
230.	7.8	7.8	6.2	5.8	5.3	9.3	7.4	6.5	5.1	5.6	9.3	6.3	8.6	5.4	3.0	3.0	3.0	3.5	3.3
240.	7.5	7.7	6.4	5.9	5.1	8.5	7.9	7.0	5.2	5.6	9.7	7.1	8.7	5.5	3.0	3.0	3.0	3.5	3.3
250.	7.1	7.3	6.3	5.6	4.8	7.3	7.2	6.7	5.1	5.5	8.7	7.0	8.9	5.6	3.0	3.0	3.1	3.5	3.3
260.	6.7	7.1	6.0	5.5	4.6	6.0	6.2	5.7	4.9	5.5	7.1	6.2	9.1	5.9	3.0	3.0	3.4	3.4	3.2
270.	6.2	6.9	5.7	5.0	4.2	5.1	5.0	4.9	4.4	5.2	5.7	5.0	9.8	6.3	3.1	3.1	3.9	3.2	3.1
280.	5.9	6.8	5.4	4.6	3.9	4.6	4.5	4.1	4.0	4.8	4.7	4.3	10.5	6.9	3.2	3.2	4.4	3.1	3.0
290.	5.9	6.4	5.0	4.3	3.9	4.3	4.0	3.9	4.0	4.4	4.4	4.0	11.2	7.4	3.2	3.2	5.1	3.0	3.0
300.	6.1	6.1	4.8	4.3	3.9	4.1	3.9	3.7	3.9	4.2	4.0	3.8	11.4	7.9	3.3	3.3	5.9	3.2	3.1
310.	6.3	5.6	4.6	4.1	3.8	3.9	3.7	3.6	3.8	4.0	3.9	3.6	10.9	7.9	3.7	3.7	6.8	3.7	3.6
320.	5.5	4.8	4.0	3.7	3.5	3.5	3.4	3.3	3.5	3.6	3.5	3.3	9.4	6.8	4.7	4.4	7.5	4.6	4.5
330.	4.3	3.7	3.4	3.2	3.1	3.1	3.1	3.1	3.1	3.2	3.1	3.1	7.4	5.4	5.1	5.1	8.2	5.2	5.0
340.	3.4	3.2	3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.8	4.4	5.1	5.1	8.5	5.5	5.1
350.	3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	4.8	4.0	5.4	5.4	8.9	5.6	4.9
360.	3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	4.1	3.8	5.4	5.3	8.8	5.9	4.8
MAX	8.9	7.8	8.1	7.4	5.9	9.3	7.9	7.0	6.5	9.1	9.7	7.1	11.4	7.9	5.5	5.4	8.9	8.5	8.0
DEGR.	190	230	150	160	170	230	240	240	180	180	240	240	300	300	10	350	350	110	120

THE HIGHEST CONCENTRATION IS 11.40 PPM AT 300 DEGREES FROM REC13.

JOB: BEACON STREET/CHESTNUT HILL AVENUE RUN: 1994 BUILD PRE-GAME ONE-HOUR
DATE: 11/19/93
TIME: 12:02:53

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 2.9 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. BEACON ST EAST WB FF	0.0	9.1	939.7	351.2	1000.	70.	AG	948.	24.5	0.0	17.0		
2. BEACON ST EAST EB FF	42.7	-9.1	982.4	332.9	1000.	70.	AG	572.	24.5	0.0	13.3		
3. BEACON ST WEST FR FL	0.0	9.1	-997.5	-60.6	1000.	266.	AG	1324.	24.5	0.0	20.6		
4. CHSNUT HILL AVE N FF	30.5	-30.5	-612.3	735.6	1000.	320.	AG	1886.	43.1	0.0	20.6		
5. CHSNUT HILL AVE S FF	27.4	-36.6	815.4	-652.2	1000.	128.	AG	1718.	43.1	0.0	20.6		
6. CNUT HILL NB RT FF	33.5	-36.6	67.1	0.0	50.	43.	AG	62.	43.1	0.0	18.2		
7. BEACON ST. EB QUEUE	-33.5	3.0	-71.7	0.4	38.	266.	AG	1924.	100.0	0.0	7.3	0.68	6.4
8. BEACON ST. WB QUEUE	14.6	15.2	43.2	25.6	30.	70.	AG	3086.	100.0	0.0	12.2	0.40	5.1
9. CHNUT HILL AVE SB QU	-22.3	27.4	-58.5	70.7	56.	320.	AG	1322.	100.0	0.0	1.2	0.71	9.4
10. CHNUT HILL AVE NB QU	24.4	-14.6	49.7	-48.7	42.	143.	AG	1322.	100.0	0.0	7.3	0.53	7.1

JOB: BEACON STREET/CHESTNUT HILL AVENUE RUN: 1994 BUILD PRE-GAME ONE-HOUR
DATE: 11/19/93
TIME: 12:02:53

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
7. BEACON ST. EB QUEUE	*	128	96	2.0	478	1600	478.10	3	3
8. BEACON ST. WB QUEUE	*	128	77	2.0	948	1600	478.10	3	3
9. CHNUT HILL AVE SB QU	*	128	66	2.0	1026	1600	478.10	3	3
10. CHNUT HILL AVE NB QU	*	128	66	2.0	772	1600	478.10	3	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (M) X	Y	Z	*
1. RESERVOIR PLACE #1	*	-36.6	71.6	1.8	*
2. RESERVOIR PLACE #2	*	-9.1	48.8	1.8	*
3. RESERVOIR PLACE #3	*	7.6	51.8	1.8	*
4. RESERVOIR PLACE #4	*	15.2	61.0	1.8	*
5. RESERVOIR PLACE #5	*	22.9	81.1	1.8	*
6. RESIDENCE A	*	51.8	42.7	1.8	*
7. RESIDENCE B	*	65.5	45.7	1.8	*
8. RESIDENCE C	*	79.2	50.3	1.8	*
9. STORE #1	*	33.5	70.1	1.8	*
10. STORE #2	*	33.5	48.8	1.8	*
11. STORE #3	*	56.4	39.6	1.8	*
12. STORE #4	*	83.8	48.8	1.8	*
13. STORE #5	*	53.3	-38.1	1.8	*
14. DONUT SHOP	*	65.5	-10.7	1.8	*
15. RESTAURANT	*	21.3	-93.0	1.8	*
16. MOVIE THEATRE	*	29.0	-108.2	1.8	*
17. CASSIDY PLAYGROUND	*	-42.7	-15.2	1.8	*
18. POOL #1	*	-59.4	44.2	1.8	*
19. POOL #2	*	-87.8	74.7	1.8	*

JOB: BEACON STREET/CHESTNUT HILL AVENUE RUN: 1994 BUILD PRE-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8	REC9	REC10	REC11	REC12	REC13	REC14	REC15	REC16	REC17	REC18	REC19
0.	3.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	4.1	3.7	5.2	5.1	8.1	5.4	4.7
10.	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.6	3.7	5.4	5.1	7.7	5.5	4.6
20.	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.3	3.7	5.3	4.6	7.0	5.6	4.5
30.	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.3	3.7	4.8	4.2	6.4	5.5	4.5
40.	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.4	3.8	4.3	4.1	6.0	5.6	4.5
50.	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.0	2.9	2.9	3.2	3.2	3.5	3.9	4.1	4.0	5.9	5.7	4.4
60.	2.9	3.0	3.0	3.0	2.9	3.2	3.3	3.3	3.0	3.0	3.5	3.6	3.4	3.9	4.0	3.9	6.4	5.7	4.5
70.	3.0	3.2	3.3	3.2	3.2	3.7	3.8	3.8	3.2	3.4	4.1	4.2	3.2	3.6	4.0	3.9	6.1	6.0	4.7
80.	3.2	3.4	3.4	3.3	3.3	4.0	4.1	4.1	3.3	3.6	4.3	4.4	3.0	3.3	3.8	3.7	5.4	6.3	5.0
90.	3.2	3.6	3.4	3.4	3.3	4.0	4.1	4.1	3.3	3.6	4.2	4.3	2.9	3.0	3.9	3.8	4.8	6.9	5.3
100.	3.5	4.1	3.6	3.3	3.3	3.9	3.9	3.9	3.3	3.6	4.1	4.1	3.0	2.9	3.9	3.8	4.6	7.4	6.0
110.	3.9	5.0	3.9	3.4	3.2	3.8	3.8	3.9	3.3	3.4	3.9	4.0	3.3	3.0	4.0	3.9	4.8	7.3	6.7
120.	4.9	5.9	4.9	3.8	3.3	3.8	3.9	3.9	3.4	3.6	4.0	4.0	4.2	3.2	3.9	3.7	4.5	7.3	7.1
130.	5.9	6.9	6.1	4.6	3.6	4.1	4.1	4.0	3.7	4.1	4.2	4.1	5.3	3.7	3.4	3.4	3.9	6.7	6.6
140.	6.8	7.2	7.4	5.7	4.0	4.3	4.3	4.3	4.0	5.0	4.5	4.3	5.8	4.0	3.0	3.0	3.3	5.7	5.6
150.	7.2	6.7	7.8	6.8	4.7	4.3	4.3	4.3	4.5	5.9	4.5	4.4	5.6	4.0	2.9	2.9	3.0	4.9	4.6
160.	7.2	6.2	7.6	7.2	5.5	4.4	4.3	4.3	5.2	7.2	4.5	4.5	5.4	4.0	2.9	2.9	2.9	4.8	4.0
170.	7.4	5.7	6.8	7.1	5.9	4.5	4.3	4.2	6.1	8.3	4.7	4.3	5.5	3.9	2.9	2.9	2.9	4.8	3.7
180.	7.6	5.4	5.6	6.2	5.7	5.3	4.3	4.2	6.5	8.9	4.9	4.4	5.7	3.9	2.9	2.9	2.9	4.7	3.4
190.	7.6	5.4	5.0	5.4	5.3	6.2	4.8	4.4	6.3	8.9	5.4	4.5	6.0	4.1	2.9	2.9	2.9	4.4	3.3
200.	7.3	5.7	4.6	4.6	4.6	7.2	5.3	4.7	5.8	8.1	6.3	4.7	6.4	4.4	2.9	2.9	2.9	4.0	3.2
210.	6.8	6.3	5.0	4.7	4.4	8.6	6.0	5.3	4.9	7.0	7.4	5.1	7.0	4.8	2.9	2.9	2.9	3.6	3.2
220.	6.5	6.8	5.4	5.0	4.7	9.5	6.8	5.8	4.8	6.1	8.6	5.7	7.5	5.1	2.9	2.9	2.9	3.5	3.2
230.	6.5	6.9	5.8	5.2	4.8	9.4	7.7	6.4	4.7	5.7	9.6	6.3	7.7	5.2	2.9	2.9	2.9	3.4	3.2
240.	6.3	6.6	5.8	5.2	4.6	8.6	7.8	6.9	4.8	5.4	9.7	7.0	7.7	5.3	2.9	2.9	2.9	3.4	3.2
250.	6.2	6.3	5.4	5.1	4.5	6.9	7.0	6.6	4.6	5.1	8.7	6.9	7.9	5.3	2.9	2.9	3.0	3.5	3.2
260.	6.1	6.1	5.4	5.0	4.3	5.8	5.9	5.6	4.5	5.0	7.1	6.1	8.1	5.6	2.9	2.9	3.3	3.4	3.2
270.	5.8	5.9	5.0	4.6	4.0	4.7	4.7	4.6	4.2	4.7	5.5	4.8	8.6	6.0	3.1	3.0	3.9	3.2	3.0
280.	5.7	5.8	4.8	4.3	3.8	4.2	4.1	3.9	3.8	4.4	4.3	4.1	9.3	6.5	3.1	3.1	4.4	3.0	2.9
290.	5.7	5.7	4.6	4.1	3.8	4.0	3.8	3.7	3.8	4.1	4.1	3.8	9.6	7.0	3.2	3.1	4.9	2.9	2.9
300.	6.0	5.5	4.6	4.1	3.8	4.0	3.7	3.6	3.8	4.1	3.9	3.7	9.6	7.5	3.2	3.2	5.7	3.1	3.0
310.	6.1	5.3	4.3	4.0	3.7	3.8	3.6	3.5	3.7	3.9	3.8	3.5	9.3	7.6	3.6	3.5	6.5	3.6	3.5
320.	5.4	4.7	3.9	3.6	3.4	3.4	3.3	3.2	3.4	3.5	3.4	3.2	8.4	6.8	4.3	4.3	7.3	4.5	4.4
330.	4.2	3.6	3.3	3.1	3.0	3.0	3.0	3.0	3.0	3.1	3.0	3.0	6.8	5.5	4.8	4.8	8.0	5.1	4.9
340.	3.3	3.1	3.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	5.5	4.5	5.0	4.9	8.1	5.3	5.0
350.	3.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	4.6	4.0	5.2	5.2	8.1	5.3	4.8
360.	3.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	4.1	3.7	5.2	5.1	8.1	5.4	4.7
MAX	7.6	7.2	7.8	7.2	5.9	9.5	7.8	6.9	6.5	8.9	9.7	7.0	9.6	7.6	5.4	5.2	8.1	7.4	7.1
DEGR.	180	140	150	160	170	220	240	240	180	180	240	240	290	310	10	350	0	100	120

THE HIGHEST CONCENTRATION IS 9.70 PPM AT 240 DEGREES FROM REC11.

JOB: BEACON ST/CHESNUT HILL DR/GATE HO. RD. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 16:03:04

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 3.0 PPM

LINK VARIABLES

LINK DESCRIPTION	*	X1	Y1	X2	Y2	*	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. BEACON ST EAST WB FF	*	0.0	-0.8	1000.0	-0.8	*	1000.	90.	AG	1518.	25.6	0.0	19.7		
2. BEACON ST WEST EB FF	*	0.0	-2.3	-1000.0	-2.3	*	1000.	270.	AG	1656.	29.7	0.0	16.7		
3. CHNUT HILL DR FR FL	*	0.0	0.0	0.0	1000.0	*	1000.	360.	AG	426.	35.8	0.0	20.5		
4. CHNUT HILL DR RT F F	*	-25.9	0.0	-4.6	22.9	*	31.	43.	AG	280.	35.8	0.0	11.2		
5. GATE HSE RD FREE FLO	*	0.0	0.0	-500.0	-866.0	*	1000.	210.	AG	40.	61.8	0.0	11.7		
6. CHNUT HILL DR L/T QU	*	-4.2	8.4	-4.2	29.8	*	21.	360.	AG	1017.	100.0	0.0	4.6	0.39	3.6
7. GATE HOUSE RD QUEUE	*	-3.4	-9.9	-5.0	-12.7	*	3.	210.	AG	1017.	100.0	0.0	3.7	0.06	0.5
8. BEACON ST. EB QUEUE	*	-9.9	-5.1	-64.1	-5.1	*	54.	270.	AG	566.	100.0	0.0	3.7	0.74	9.0
9. BEACON ST. WB QUEUE	*	9.9	0.5	67.8	0.5	*	58.	90.	AG	566.	100.0	0.0	3.7	0.79	9.7

JOB: BEACON ST/CHESNUT HILL DR/GATE HO. RD. RUN: 1993 EXISTING POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 16:03:04

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
6. CHNUT HILL DR L/T QU*	120	88	2.0	146	1600	516.80	3	3
7. GATE HOUSE RD QUEUE*	120	88	2.0	22	1600	516.80	3	3
8. BEACON ST. EB QUEUE*	120	49	2.0	663	1600	516.80	3	3
9. BEACON ST. WB QUEUE*	120	49	2.0	709	1600	516.80	3	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (M) X	Y	Z
1. ATHLETIC FIELD	-30.5	22.9	1.8
2. BENCH	14.5	21.3	1.8
3. #96 RESIDENCE	3.8	-19.8	1.8
4. #114 RESIDENCE	-30.5	-19.8	1.8

JOB: BEACON ST/CHESNUT HILL DR/GATE HO. RD.   RUN: 1993 EXISTING POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) REC1	REC2	REC3	REC4
0.	*	3.2	3.5	5.1	5.2
10.	*	3.3	3.2	4.7	5.4
20.	*	3.3	3.1	4.5	5.4
30.	*	3.3	3.0	4.4	5.8
40.	*	3.3	3.0	4.5	5.7
50.	*	3.3	3.0	4.7	5.5
60.	*	3.4	3.0	4.6	5.3
70.	*	3.7	3.1	4.6	5.1
80.	*	4.3	3.3	4.4	4.7
90.	*	5.0	3.8	4.0	4.2
100.	*	5.4	4.2	3.4	3.5
110.	*	5.4	4.4	3.1	3.1
120.	*	5.1	4.5	3.0	3.0
130.	*	4.9	4.6	3.0	3.0
140.	*	4.7	4.5	3.0	3.0
150.	*	4.6	4.5	3.0	3.1
160.	*	4.3	4.4	3.0	3.1
170.	*	4.4	4.4	3.0	3.1
180.	*	4.4	4.3	3.0	3.1
190.	*	4.3	4.2	3.0	3.1
200.	*	4.3	4.5	3.0	3.1
210.	*	4.3	4.7	3.1	3.1
220.	*	4.3	4.9	3.1	3.0
230.	*	4.2	5.4	3.1	3.0
240.	*	4.2	5.9	3.1	3.0
250.	*	4.2	6.2	3.2	3.1
260.	*	4.1	6.2	3.7	3.5
270.	*	3.8	5.6	4.5	4.2
280.	*	3.3	4.9	5.2	4.6
290.	*	3.1	4.3	5.4	4.8
300.	*	3.0	3.9	5.5	4.9
310.	*	3.0	3.7	5.4	5.0
320.	*	3.0	3.6	5.5	4.9
330.	*	3.0	3.5	5.4	4.9
340.	*	3.0	3.6	5.4	4.9
350.	*	3.1	3.6	5.2	5.0
360.	*	3.2	3.5	5.1	5.2
MAX	*	5.4	6.2	5.5	5.8
DEGR.	*	100	250	320	30

THE HIGHEST CONCENTRATION IS 6.20 PPM AT 250 DEGREES FROM REC2 .

JOB: BEACON ST/CHESNUT HILL DR/GATE HO. RD. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 16:04:38

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 370. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 2.9 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (M)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (M)	W (M)	V/C	QUEUE (VEH)
1. BEACON ST EAST WB FF	0.0	-0.8	1000.0	-0.8	1000.	90.	AG	1518.	24.5	0.0	19.7		
2. BEACON ST WEST EB FF	0.0	-2.3	-1000.0	-2.3	1000.	270.	AG	1656.	28.7	0.0	16.7		
3. CHNUT HILL DR FR FL	0.0	0.0	0.0	1000.0	1000.	360.	AG	426.	35.0	0.0	20.5		
4. CHNUT HILL DR RT F F	-25.9	0.0	-4.6	22.9	31.	43.	AG	280.	35.0	0.0	11.2		
5. GATE HSE RD FREE FLO	0.0	0.0	-500.0	-866.0	1000.	210.	AG	40.	58.9	0.0	11.7		
6. CHNUT HILL DR L/T QU	-4.2	8.4	-4.2	29.8	21.	360.	AG	940.	100.0	0.0	4.6	0.39	3.6
7. GATE HOUSE RD QUEUE	-3.4	-9.9	-5.0	-12.7	3.	210.	AG	940.	100.0	0.0	3.7	0.06	0.5
8. BEACON ST. EB QUEUE	-9.9	-5.1	-64.1	-5.1	54.	270.	AG	524.	100.0	0.0	3.7	0.74	9.0
9. BEACON ST. WB QUEUE	9.9	0.5	67.8	0.5	58.	90.	AG	524.	100.0	0.0	3.7	0.79	9.7

JOB: BEACON ST/CHESNUT HILL DR/GATE HO. RD. RUN: 1994 BUILD POST-GAME ONE-HOUR
DATE: 11/23/93
TIME: 16:04:38

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
6. CHNUT HILL DR L/T QU	*	120	88	2.0	146	1600	478.10	3	3
7. GATE HOUSE RD QUEUE	*	120	88	2.0	22	1600	478.10	3	3
8. BEACON ST. EB QUEUE	*	120	49	2.0	663	1600	478.10	3	3
9. BEACON ST. WB QUEUE	*	120	49	2.0	709	1600	478.10	3	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (M) X	Y	Z	*
1. ATHLETIC FIELD	*	-30.5	22.9	1.8	*
2. BENCH	*	14.5	21.3	1.8	*
3. #96 RESIDENCE	*	3.8	-19.8	1.8	*
4. #114 RESIDENCE	*	-30.5	-19.8	1.8	*

JOB: BEACON ST/CHESNUT HILL DR/GATE HO. RD. RUN: 1994 BUILD POST-GAME ONE-HOUR

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 0.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) REC1	REC2	REC3	REC4
0.	*	3.1	3.4	5.0	4.9
10.	*	3.2	3.1	4.6	5.1
20.	*	3.2	3.0	4.4	5.3
30.	*	3.2	2.9	4.3	5.4
40.	*	3.2	2.9	4.3	5.3
50.	*	3.2	2.9	4.4	5.3
60.	*	3.3	2.9	4.5	5.0
70.	*	3.6	3.0	4.5	4.8
80.	*	4.1	3.2	4.3	4.5
90.	*	4.9	3.7	3.8	4.1
100.	*	5.2	4.1	3.3	3.4
110.	*	5.1	4.3	3.0	3.0
120.	*	4.9	4.3	2.9	2.9
130.	*	4.7	4.3	2.9	2.9
140.	*	4.6	4.3	2.9	2.9
150.	*	4.4	4.2	2.9	2.9
160.	*	4.2	4.2	2.9	3.0
170.	*	4.3	4.1	2.9	3.0
180.	*	4.3	4.1	2.9	3.0
190.	*	4.2	4.1	2.9	3.0
200.	*	4.2	4.3	2.9	3.0
210.	*	4.2	4.5	3.0	2.9
220.	*	4.1	4.8	3.0	2.9
230.	*	4.1	5.2	3.0	2.9
240.	*	4.1	5.5	3.0	2.9
250.	*	4.1	6.0	3.1	3.0
260.	*	4.0	5.8	3.6	3.4
270.	*	3.7	5.4	4.4	4.1
280.	*	3.2	4.7	5.0	4.5
290.	*	3.0	4.1	5.3	4.7
300.	*	2.9	3.8	5.2	4.8
310.	*	2.9	3.5	5.1	4.8
320.	*	2.9	3.4	5.2	4.7
330.	*	2.9	3.4	5.0	4.6
340.	*	2.9	3.5	5.2	4.6
350.	*	3.0	3.5	5.1	4.7
360.	*	3.1	3.4	5.0	4.9
MAX	*	5.2	6.0	5.3	5.4
DEGR.	*	100	250	290	30

THE HIGHEST CONCENTRATION IS 6.00 PPM AT 250 DEGREES FROM REC2 .

APPENDIX C

MOBILE5a MODEL OUTPUT

MOBILE CO EMISSIONS - BOSTON COLLEGE - 1993 MICROSCALE
MOBILE5a (26-Mar-93)

M 49 Warning: 1.00 MYR sum not = 1. (will normalize)
M 49 Warning: 1.00 MYR sum not = 1. (will normalize)
M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

I/M program selected:

Start year (January 1):	1983
Pre-1981 MYR stringency rate:	12%
First model year covered:	1979
Last model year covered:	2020
Waiver rate (pre-1981):	1.%
Waiver rate (1981 and newer):	1.%
Compliance Rate:	85.%
Inspection type:	Computerized Test and Repair
Inspection frequency	Annual
Vehicle types covered:	LDGV - Yes
	LDGT1 - Yes
	LDGT2 - Yes
	HDGV - No
1981 & later MYR test type:	Idle

Cutpoints, HC: 220.000 CO: 1.200 NOx: 999.000

Stage II program selected:

Start year (January 1):	1991
Phase-in period (yrs.):	3
Percent Efficiency for LDGV & LDGT:	95.%
Percent Efficiency for HDGV:	95.%

BOSTON, MASS. Minimum Temp: 29. (F) Maximum Temp: 30. (F)
Period 1 RVP: 13.5 Period 2 RVP: 13.5 Period 2 Start Yr: 1989

VOC HC emission factors include evaporative HC emission factors.

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1993 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
VMT Mix:	0.625	0.182	0.085		0.038	0.004	0.001	0.059	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	214.03	221.44	257.34	232.93	184.15	5.39	6.33	38.51	254.46	206.715

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1993 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	
VMT Mix:	0.625	0.182	0.085		0.038	0.004	0.001	0.059	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	61.47	64.65	73.03	67.33	97.89	3.03	3.56	21.68	70.42	61.832

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1993 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	15.0	15.0	15.0		15.0	15.0	15.0	15.0	15.0	
VMT Mix:	0.625	0.182	0.085		0.038	0.004	0.001	0.059	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	44.40	47.15	52.16	48.76	68.81	2.19	2.57	15.64	45.74	44.596

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1993 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	20.0	20.0	20.0		20.0	20.0	20.0	20.0	20.0	
VMT Mix:	0.625	0.182	0.085		0.038	0.004	0.001	0.059	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	35.79	38.53	42.04	39.65	51.11	1.65	1.94	11.81	34.38	35.816

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1993 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	25.0	25.0	25.0		25.0	25.0	25.0	25.0	25.0	
VMT Mix:	0.625	0.182	0.085		0.038	0.004	0.001	0.059	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	29.79	32.03	35.00	32.98	40.10	1.31	1.53	9.34	27.41	29.675

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1993 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	30.0	30.0	30.0		30.0	30.0	30.0	30.0	30.0	
VMT Mix:	0.625	0.182	0.085		0.038	0.004	0.001	0.059	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	25.76	27.58	30.24	28.44	33.24	1.08	1.27	7.72	22.37	25.555

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1993 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	35.0	35.0	35.0		35.0	35.0	35.0	35.0	35.0	
VMT Mix:	0.625	0.182	0.085		0.038	0.004	0.001	0.059	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	22.88	24.39	26.82	25.17	29.12	0.94	1.10	6.69	18.64	22.637

DRIVER calls completed.

MOBILE CO EMISSIONS - BOSTON COLLEGE - 1994 MICROSCALE
MOBILE5a (26-Mar-93)

M 49 Warning: 1.00 MYR sum not = 1. (will normalize)
M 49 Warning: 1.00 MYR sum not = 1. (will normalize)
M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

I/M program selected:

Start year (January 1):	1983
Pre-1981 MYR stringency rate:	12%
First model year covered:	1980
Last model year covered:	2020
Waiver rate (pre-1981):	1.%
Waiver rate (1981 and newer):	1.%
Compliance Rate:	85.%
Inspection type:	Computerized Test and Repair
Inspection frequency	Annual
Vehicle types covered:	LDGV - Yes
	LDGT1 - Yes
	LDGT2 - Yes
	HDGV - No
1981 & later MYR test type:	Idle

Cutpoints, HC: 220.000 CO: 1.200 NOx: 999.000

Stage II program selected:

Start year (January 1):	1991
Phase-in period (yrs.):	3
Percent Efficiency for LDGV & LDGT:	95.%
Percent Efficiency for HDGV:	95.%

BOSTON, MASS. Minimum Temp: 29. (F) Maximum Temp: 30. (F)
Period 1 RVP: 13.5 Period 2 RVP: 13.5 Period 2 Start Yr: 1989

VOC HC emission factors include evaporative HC emission factors.

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1994 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
VMT Mix:	0.621	0.185	0.086		0.038	0.003	0.001	0.061	0.005	

Composite Emission Factors (Gm/Mile)

Exhaust CO:	198.41	203.88	236.77	214.31	166.80	5.41	6.24	37.80	254.46	191.253

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1994 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	
VMT Mix:	0.621	0.185	0.086		0.038	0.003	0.001	0.061	0.005	

Composite Emission Factors (Gm/Mile)

Exhaust CO:	58.70	61.60	69.34	64.05	88.67	3.05	3.51	21.28	70.42	58.869

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1994 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	15.0	15.0	15.0		15.0	15.0	15.0	15.0	15.0	
VMT Mix:	0.621	0.185	0.086		0.038	0.003	0.001	0.061	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	43.09	45.73	50.44	47.22	62.33	2.20	2.53	15.36	45.74	43.114

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1994 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	20.0	20.0	20.0		20.0	20.0	20.0	20.0	20.0	
VMT Mix:	0.621	0.185	0.086		0.038	0.003	0.001	0.061	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	35.13	37.81	41.16	38.87	46.29	1.66	1.91	11.60	34.38	35.002

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1994 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	25.0	25.0	25.0		25.0	25.0	25.0	25.0	25.0	
VMT Mix:	0.621	0.185	0.086		0.038	0.003	0.001	0.061	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	28.89	31.03	33.87	31.93	36.32	1.31	1.51	9.17	27.41	28.681

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1994 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	30.0	30.0	30.0		30.0	30.0	30.0	30.0	30.0	
VMT Mix:	0.621	0.185	0.086		0.038	0.003	0.001	0.061	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	24.70	26.44	28.97	27.24	30.11	1.09	1.25	7.58	22.37	24.451

M111 Error: The calculated exhaust temperature 31.3 is < daily min temp or > daily max temp

Emission factors are as of Jan. 1st of the indicated calendar year.

User supplied veh registration distributions.

Cal. Year: 1994 I/M Program: Yes Ambient Temp: 31.3 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.
Reformulated Gas: No

Veh. Type:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Veh. Speeds:	35.0	35.0	35.0		35.0	35.0	35.0	35.0	35.0	
VMT Mix:	0.621	0.185	0.086		0.038	0.003	0.001	0.061	0.005	
Composite Emission Factors (Gm/Mile)										
Exhaust CO:	21.71	23.15	25.46	23.88	26.37	0.94	1.08	6.56	18.64	21.456

DRIVER calls completed.

APPENDIX D

CORRESPONDENCE WITH THE BOSTON REDEVELOPMENT AUTHORITY

J1026APN

Tech Environmental, Inc.
Reservoir Place
1601 Trapelo Road
Waltham, MA 02154
(617) 890-2220

November 23, 1993 Ref 1026

Mr. Richard Mertens
Boston Redevelopment Authority
One City Hall Square
Room 944
Boston, MA 02201

Re: *Modeling Protocol the Boston College Alumni Stadium Addition - Supplemental Microscale Air Quality Analysis for the PIR*

Dear Mr. Mertens:

Thank you for meeting with me today, along with Keith Grillo (Mass. DEP), regarding the Boston College Alumni Stadium expansion. The following is a summary of the microscale air quality modeling protocol for the project.

Please keep in mind that this protocol is only for the addition to the stadium. Additional analyses will be performed for the other Boston College expansion projects.

Intersection Selection

The intersections which will be included in the microscale analysis will be chosen according to the BRA Scope. The BRA Scope requires a microscale analysis for carbon monoxide (CO) for intersections which operate at level-of-service (LOS) D, where the project adds 10 percent or more to the traffic volumes, or for intersections which operate at LOS E or F. Using these criteria, the following seven intersections were chosen for analysis:

(1) Commonwealth Avenue/Lake Street/More Drive
(2) Commonwealth Avenue/Foster Street
(3) Commonwealth Avenue/South Street
(4) Commonwealth Avenue/Chestnut Hill Drive
(5) Commonwealth Avenue/Chestnut Hill Avenue
(6) Beacon Street/Chestnut Hill Avenue (Cleveland Circle)
(7) Beacon Street/Chestnut Hill Drive.

Only the intersection of Commonwealth Avenue and Foster Street will be modeled as an unsignalized intersection.

Traffic Volumes and Cases to be Studied

Worst-case traffic volumes will be used to predict maximum one-hour and eight-hour CO concentrations at selected sensitive locations (receptors) at each intersection for the following cases:

- 1993 Existing
- 1994 Build with Mitigation.

Peak one-hour traffic volumes will be provided by traffic engineers at Rizzo Associates Inc. of Natick, Massachusetts. Peak one-hour average traffic volumes on gameday Saturdays, both before and after the game, will be considered. The peak traffic volumes for the period which shows the poorest LOS will be used for the modeling.

Traffic Mitigation

Transportation demand management measures proposed by Boston College will be taken into account for both the 1993 Existing and the 1994 Build analyses.

Receptors

Receptors will be located on each intersection approach at locations where the general public will have access. Following EPA guidance, all receptors will be placed at a height of 1.8 m and will be located at least 3 meters from roadway curbsides and at least 10 meters from cross streets. Detailed maps of each intersection were left with you at the protocol meeting. These maps indicate the location of each sensitive receptor to be input into the EPA CAL3QHC intersection modeling program. Additional receptors for MBTA stops will be added.

CAL3QHC Intersection Model

Maximum one-hour CO concentrations will be predicted using Version 2.0 of the EPA CAL3QHC model.[1] This model includes the EPA CALINE3 dispersion model. All output from the CAL3QHC program will be included with the report.

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[1]U.S. EPA, User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, Office Of Air Quality Planning and Standards, Research Triangle Park, November 1992.

Maximum eight-hour CO concentrations will be predicted by multiplying the maximum predicted one-hour concentration at each receptor by a persistence factor of 0.7.[2]

Background CO Concentrations

The output from the CAL3QHC model will be added to conservative background suburban CO concentrations of 3.0 ppm (one-hour average) and 2.1 ppm (eight-hour average) for the existing case, and 2.9 ppm (one-hour average) and 2.0 ppm (eight-hour average) for the 1994 Build case. Background CO values for 1994 were determined by scaling the existing background values by the ratio of the average predicted decrease in CO emission factors and the ratio of the increase in No-Build traffic volumes, between 1993 and 1994.

The sum of the CAL3QHC model predicted CO concentrations plus background will be compared to the Massachusetts and National Ambient Air Quality Standards (NAAQS) for CO. If any violations are predicted for the 1994 Build case, mitigation measures beyond those proposed by Boston College will be developed and tested.

Traffic Control Inputs

The CAL3QHC model also requires the input of total and red signal timing for signalized intersections and traffic capacities for unsignalized intersections. Signalized and police officer controlled intersections will be modeled with signal timings provided by the traffic engineers. Capacities for turning movements at Commonwealth Avenue and Foster Street will be determined by methods used in the Highway Capacity Manual (HCM) 1985 which have been programmed in the Capacity of Intersection: CTPS' HCM (CINCH) Program.

Meteorological Inputs

The CAL3QHC model also requires the selection of certain meteorological parameters to predict CO concentrations. The following Mass. DEP approved meteorological parameters will be selected:

Roughness Length:	370 cm (Apartment Residential)
Mixing Height:	1000 meters

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[2]U.S. EPA, Guidelines for Modeling CO from Roadway Intersections, EPA-454/R-92-005, Office of Air Quality Planning and Standards, Research Triangle Park, November 1992.

Wind Speed:	1.0 m/s (minimum)
Wind Direction:	360° in 10° increments
Stability Class:	Class D.

Carbon Monoxide Emission Factors

The MOBILE5a Emission Factor Model[3] will be used to predict the CO emission rates for moving (free flow) and idling vehicles at each intersection. The calculation of idle emission factors for 1993 and 1994 will be done using the composite CO emission factor for a speed of 2.5 mph, following EPA guidance.[4] The input parameters to be used with the MOBILE5a model will be consistent with these required by DEP guidance dated August 1993. This guidance allows credit to be taken for an inspection and maintenance (I/M) program and Stage II (vehicle refueling) emission controls, and requires the use of Massachusetts vehicle registration by age data. MOBILE5a model output will be included with the analysis.

MOBILE5a predicted free-flow emission rates are sensitive to vehicle speeds. Vehicle speeds input to the model will be provided by Rizzo Associates Inc. and will not exceed posted speed limits.

I would appreciate a letter confirming that this protocol is acceptable to your office. Please do not hesitate to contact me if you need any additional information or if you have any questions. Thank you.

Sincerely,

TECH ENVIRONMENTAL, INC.

Robert J. Rossi

Robert J. Rossi, Ph.D., C.C.M.

RJR/PL1

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[3]MOBILE5a is the "corrected" version of the MOBILE5.0 model and was released March 26, 1993. Only Chapter two of the MOBILE5.0 User's Guide is available at this time.

[4]U.S. EPA, "MOBILE5 Information Sheet #2: Estimating Idle Emission Factors Using MOBILE5, Ann Arbor, July 30, 1993.

Boston
Redevelopment
Authority

Clarence J. Jones, *Chairman*
Paul L. Barrett, *Director*

December 1, 1993

Mr. Robert J. Rossi
Tech Environmental, Inc.
Reservoir Place
1601 Trapelo Road
Waltham, MA 02154

RE: MODELING PROTOCOL FOR THE BOSTON COLLEGE ALUMNI STADIUM ADDITION - SUPPLEMENTAL MICROSCALE AIR QUALITY ANALYSIS FOR THE PIR

Dear Mr. Rossi:

I have reviewed the modeling protocol for the microscale air quality analysis for the Boston College Alumni Stadium Addition project, dated November 23, 1993, and confirm that this protocol is acceptable.

Sincerely,

Richard B. Mertens
Environmental Review Officer

One City Hall Square
Boston, MA 02201-1007
Telephone (617) 722-4300
Fax (617) 367-5916

BOSTON COLLEGE ALUMNI STADIUM ADDITION PROJECT ACOUSTICAL ANALYSIS AND NOISE IMPACT ASSESSMENT

Prepared for:

Rizzo Associates, Inc.
235 West Central Street
Natick, MA 01760

Prepared by:

Acentech Incorporated
125 Cambrdige Park Drive
Cambridge, MA 02140

(617) 499-8000

December 7, 1993

1.0 INTRODUCTION AND SUMMARY

From an acoustical standpoint, the most significant aspects of the modifications to Boston College's existing stadium facility proposed under the Alumni Stadium Addition Project involve the provision of seats for an additional 12,000 fans at the stadium – bringing the stadium's capacity to a total of 44,500 seats – and the installation of a new sound reinforcement system. The purpose of this report is to document the acoustical analyses that have gone into a noise impact assessment of the proposed stadium modifications associated with the Boston College Alumni Stadium Addition Project.

Briefly, the assessment of the potential noise impacts of the expanded stadium facility has been based on a comparison between the acoustical environment that currently exists in the surrounding residential community during a Boston College home football game and the acoustical environment that is expected to result once the proposed stadium expansion is complete and additional fans attend future home games. Qualitative acoustical assessments were made in a number of residential areas during a game, both in Newton and Brighton, to assess the audibility of stadium-related noise. In general, it was found that the degree of audibility in Brighton neighborhoods was extremely low, while both crowd noise and sound system noise were quite evident in the Newton community immediately south of the stadium.

To quantify game noise levels, and to develop a fair representation of the existing acoustical environment in the area most likely to be impacted by noise from the expanded facility, ambient noise levels were measured both at a nearby Newton residence and at the periphery of the stadium during a home football game. The results of these measurements are documented in this report.

It was found during the ambient noise level survey that the game time acoustical environment in the Newton neighborhood (south of the stadium) is affected primarily by three distinct noise sources: crowd noise from the stadium, traffic noise (mainly from cars on Beacon Street), and announcements from the stadium's sound reinforcement system. Not unexpectedly, the highest ambient noise levels were found in the community during exciting events on the field – during a long touchdown play, kickoff, or defensive stand, for example, the "roar" of the crowd was the dominant source of noise along Beacon Street and further south into the Newton community. Traffic noise was evident during lulls in the action, or when individual vehicles passed the observers' locations. Noise from the sound system was generally noticeable throughout the game, primarily because of its distinct nature, but did not seem to significantly influence measured community noise levels. Again, game noise was judged to be generally inaudible in the Brighton neighborhoods north and northeast of the BC campus.

There are no applicable federal, state or local regulations that govern permissible noise emission levels from either the existing or the proposed stadium facilities, thus there are no numerical "compliance standards" against which the acoustical acceptability of the expanded stadium can be judged. Nevertheless, Boston College has committed to a careful acoustical

review of the stadium design – particularly of the new sound system – that will help limit the overall noise impact of the project on the surrounding community.

The remainder of this report discusses in more detail the results of the community noise level survey made during a home game, outlines the expected changes in noise level likely to result from the increase in seating capacity of the proposed stadium expansion, and addresses proposed design characteristics of the new sound system that will help mitigate against adverse community noise impact.

2.0 THE EXISTING GAME TIME ACOUSTICAL ENVIRONMENT

One of the more important aspects of assessing the potential noise impact of a new or modified facility is the evaluation of the existing acoustical environment in the area likely to be influenced by noise from the new noise source(s). In general, "existing ambient noise levels" serve as the baseline against which the projected levels of noise from the new facility are compared, and the impact assessment is based largely on expected increases in overall ambient noise levels brought about by the operation of the new source: Where large increases in ambient noise levels are anticipated, noise impacts may well be expected to be significant; conversely, where little or no increases are expected after the new facility goes into operation, it is likely that the associated noise impacts will also be minimal.

2.1 EXISTING GAME TIME ACOUSTICAL CONDITIONS – A QUALITATIVE VIEW

Boston College's Alumni Stadium sits near the southeast corner of the BC campus, abutting the Chestnut Hill Reservoir to the east, the BC campus to the north and west, and, to the south, the residential Chestnut Hill neighborhood of Newton; residential neighborhoods in Brighton lie further to the north, mostly north of Commonwealth Avenue. The stadium itself sits in a slight valley; the abutting Chestnut Hill neighborhood slopes upward to the south, so the Newton residences generally overlook the stadium. To the north, the topography rises to about Commonwealth Avenue, then drops back down, so Brighton neighborhoods are generally below the stadium level, and their lines-of-sight to the stadium are largely blocked by the intervening hill. The immediate stadium area is fairly open, but the off-campus areas are well populated with trees.

Acoustical observations were made throughout the stadium area during the Boston College – Tulane University football game, 30 October 1993. The weather that day was fairly typical of many late fall afternoons – cold and rainy. Nevertheless, the game was sold out, and the stands were full by the second quarter of the game.

From the acoustical observations made that day, it is clear that stadium noise is readily apparent throughout the Chestnut Hill neighborhood immediately south of the Boston College campus. Crowd noise was generally audible at all times throughout the nearby Newton residences along Acacia, Reservoir, Nancy, and Lee Roads. Occasional lulls in crowd noise

were observed, during which times noise from traffic on Beacon Street could be plainly heard. However, crowd noise clearly dominated the overall noise levels throughout the area during the game. Voice announcements over the stadium's sound system were generally always audible as well throughout the area, as was the band during cheers and half time activities.

Acoustical observations were also made near Brighton residences in the Undine Road neighborhood off Lake Street, and on Wade Street, off Commonwealth Avenue. At the time, no stadium noise was audible. However, meteorological conditions may have come into play: wet pavement may have allowed increased traffic noise along Commonwealth Avenue to mask stadium noise, for example. Nevertheless, it was judged that stadium noise would not likely be a significant contributor to ambient noise levels in these areas, even under the best propagation conditions.

2.2 QUANTIFYING THE ACOUSTICAL ENVIRONMENT – NOISE LEVEL MEASUREMENTS

Acoustical measurements were made to quantify stadium noise in the Chestnut Hill neighborhood; it was judged that game noise was not audible in Brighton, and that no useful quantitative data could be collected there.

To gather data on the short- and long-term variations in overall ambient sound levels, automated acoustical monitors were used to continuously collect and statistically analyze samples of the overall (A-weighted) sound level at two noise monitoring positions around the stadium. One monitoring position was chosen very close to the stadium: on a stairwell to the parking deck overlooking the end zone at the southeast corner of the field; noise levels measured at this monitoring position were judged to very closely track the amount of noise generated inside the stadium, and would serve as a good reference position against which to correlate noise levels measured in the community. The other monitoring position was chosen on the sidewalk in front of 9 Acacia Street, some 100 feet off Beacon Street, across from the stadium, with a direct line-of-sight to the southern end of the field. The two monitoring positions are shown in Figure 1.

The automatic monitors, Larson-Davis Model 870 Statistical Noise Analyzers, measured the instantaneous ambient sound pressure level eight times per second, storing each sample into a histogram from which various statistical metrics could be calculated over defined time periods; for the BC surveys, a one-minute interval duration was selected. For each successive one-minute interval, the maximum and minimum levels, and various "L(n)" values (the level exceeded "n" percent of each interval) were recorded, from which a "time history" of the ambient sound level variations could be recreated.

The L(90) level (the level exceeded 90 percent of the time) and the L(10) level (the level exceeded 10 percent of the time) were chosen as the most important metrics to use for the assessment of the influence of game noise on the existing acoustical environment in the area. The L(90) level is commonly used to define the "existing background" level because it

represents the "noise floor" of an area, or the level below which ambient levels rarely fall; in this case, the L(90) level represented the levels that occurred during the quietest six seconds of every minute during the monitoring period. The L(10) level gives a good sense of the "near peak" levels that occurred every minute, such as might occur during a kick-off or long touchdown run, when the crowd is cheering loudly.

Acoustical data at the community monitoring position was collected beginning at about 1:00 p.m. on Saturday, 30 October 1993, the day of the BC/Tulane game; stadium data collection began with the kickoff, at 1:30 p.m. Acoustical data was continuously collected for a period of about three hours, through the first half of the game, half time, and into the beginning of the fourth quarter of the game; by that point, rain and the game's lopsided score had driven many fans away and measurements were discontinued.

Figure 2 summarizes the results of the survey. The figure shows the range of acoustical data measured at each of the two positions throughout the course of the game: the upper band of data represents the range of levels – from the L(90) background level to the L(10) near-peak level – measured at the rim of the stadium; the lower band represents the same range of levels measured in the community.

A brief examination of the time histories shown in Figure 2 indicates a number of interesting points about the effects of stadium noise on community noise levels. Most obvious is the general range of noise levels measured at the two positions: stadium noise levels were generally found to fall in the mid-60s to mid-70s dBA range, with occasional peaks into the low to mid-80s dBA; noise levels in the community were found to fall mostly between the mid-50s dBA to low 60s dBA, with occasional peaks of about 70 dBA.

In general, a fairly good correlation can be seen between peaks in the levels measured at the rim of the stadium with the peaks measured in the community; this is more evident in Figure 3, which simply plots the L(10) levels measured at the two positions. In general, this shows the effect of crowd noise at the two locations – when crowd noise goes up, as indicated by increases in the levels measured at the stadium rim, noise levels in the community also go up. Less of a causal relationship appears to exist in the minor noise level rises and dips during lulls in crowd noise – it is more difficult to correlate these fluctuations between the two monitoring positions.

Another interesting observation is the general lack of correlation that appears to exist between the L(90) levels at the two positions, and, further, the relatively slight influence that stadium noise appears to have on background (L(90)) levels in the community. No obvious trend shows up in the L(90) level time history plot at the Acacia Street position: background levels measured during the period just before the game seem to be about the same level – with generally the same level of fluctuation – as measured during the game itself. Figure 4, depicting just the measured L(90) levels at each position, shows this a bit more clearly.

2.3 CONCLUSIONS FROM ACOUSTICAL MEASUREMENT PROGRAM

From the results of the game noise tests, it can be concluded that noise levels in the Chestnut Hill neighborhood to the south of the stadium are, in fact, strongly influenced by noise from the cheering fans in the stadium, particularly when exciting events are taking place on the field. By comparing the L(10) levels measured at 9 Acacia Street with those measured at the southern rim of the stadium, it appears that crowd noise can produce noise levels upwards of 70 dBA in the community during short periods; lower peaks in the levels of crowds noise can also be seen to influence community noise levels, as well.

3.0 NOISE IMPACT ASSESSMENT

To keep a realistic perspective on the potential noise impacts of the proposed Alumni Stadium Addition project, it is important to recognize that noise is currently being generated during home games at the existing stadium facility; the proposed project will have, at worst, an incremental effect on the level of noise emissions currently produced during home games, and that noise will be similar in nature to that to which the surrounding community has already become exposed – no fundamentally new noise will be introduced into the area.

From a strictly numerical, computational perspective, the potential for increases in crowd noise is a function of the proposed increase in the number of screaming fans: given a base of 32,500 fans, it may be expected that an additional 12,000 fans would add about another 37 percent – a little less than 1.5 dB – to the total "noise generating capacity" of the stadium. Thus, all other parameters being equal, it could be expected that the proposed stadium expansion could result in community noise levels on the order of 1 to 2 dB higher than currently exist. Such small noise level increases are generally considered insignificant, even for continuously operating noise sources, and are not likely even to be noticeable in the community. Furthermore, in practice (as evidenced by the measurements made during an actual game), crowd noise levels seem to be more a factor of how well the home team is doing – and how exciting the play is at any given moment – than they are a function of the number of people in attendance; from moment to moment, crowd noise levels are likely to vary over a far wider range than could be attributed to the proposed addition of 12,000 fans. Thus, it is expected that the incremental community noise impact related to the increased seating capacity associated with the expansion of the stadium will be insignificant.

4.0 NOISE IMPACT MITIGATION

One feature of the expansion project may actually benefit the acoustical impact of the stadium on the surrounding community – the redesigned sound system. It was found that the existing sound system was almost constantly audible across Beacon Street from the stadium. Although the sound system noise levels were not found to be particularly high in the community, the information content of the messages broadcast over the loudspeakers causes one to "focus" on

the sound system message while the subconscious attempts to understand it – the result is that this type of noise tends to be more annoying than noise of a more random nature, such as crowd noise.

It was noted during the game that the existing sound reinforcement system is operated at a relatively high level because the uniformity of coverage (in the stadium) is fairly poor, and the system must be loud to achieve a nominal level of intelligibility inside the stadium. It was also noted that the existing sound system is not equipped with any crowd noise compensation features, so the system is operated at the same gain (volume) whether the crowd is noisy or quiet. As such, most of the time the system is operated louder than it needs to be.

The result is that the current levels of sound system noise in the stadium are generally higher than they might need to be if a more uniform coverage system, with crowd noise compensation, were to be installed. These high levels of sound system noise propagate out into the community, where they can result in higher levels of annoyance than may be necessary.

As part of the proposed action under the stadium expansion plan, BC will be installing a new sound system in the stadium. It will be designed as a distributed system, allowing relatively lower sound levels to be employed by a larger number of loudspeakers to achieve the desired level of coverage and intelligibility, and it will be equipped with crowd noise compensation features. As such, it is expected that the system can be operated at lower sound levels than the existing system. As a result, it is also expected that community noise impacts from the sound system will be somewhat less than with the current system.

5.0 CONCLUSIONS

It is expected that Boston College's Alumni Stadium Addition Project will result in no significant noise impacts on the surrounding community. In general, the increase in the seating capacity of the stadium proposed by BC may result in nominal increases in the amount of crowd noise generated at any given time, but any such increases are likely to be indistinguishable from normal fluctuations in crowd noise levels during the course of a game. The proposed installation of a new distributed sound system in the stadium is expected to provide better coverage inside the stadium, with the result that sound system noise levels outside the stadium may be slightly quieter after the expansion than they are currently.

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Boston College
Alumni Stadium Addition

0 420
Scale in Feet

N

Figure 1:

Noise Monitoring Locations

Figure 2
BC vs. Tulane, at BC -- 30 October 93
Comparison of Stadium vs. Community Noise Levels

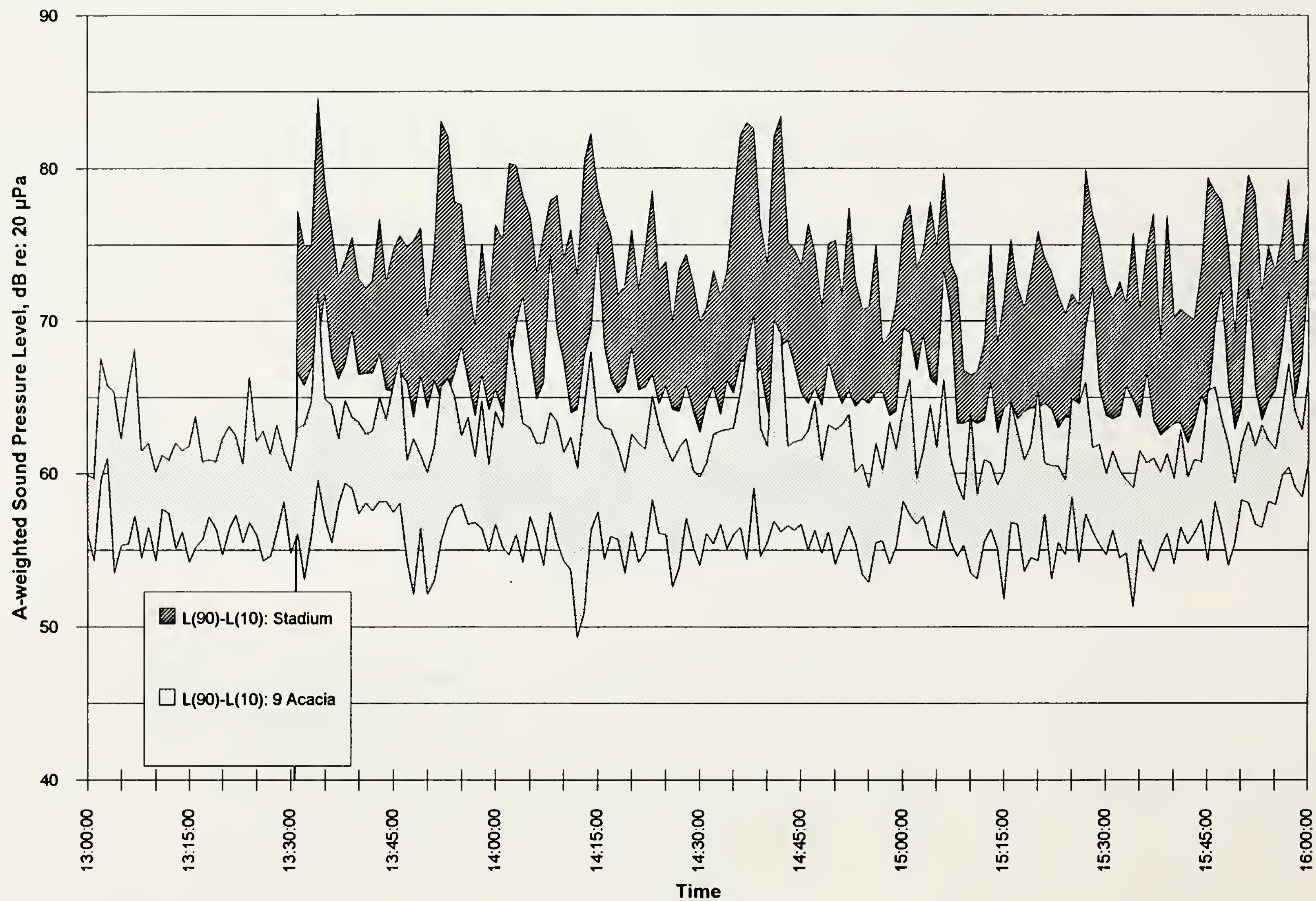


Figure 3
BC vs. Tulane, at BC -- 30 October 93
Comparison of Stadium vs. Community Noise: Measured L(10) Levels

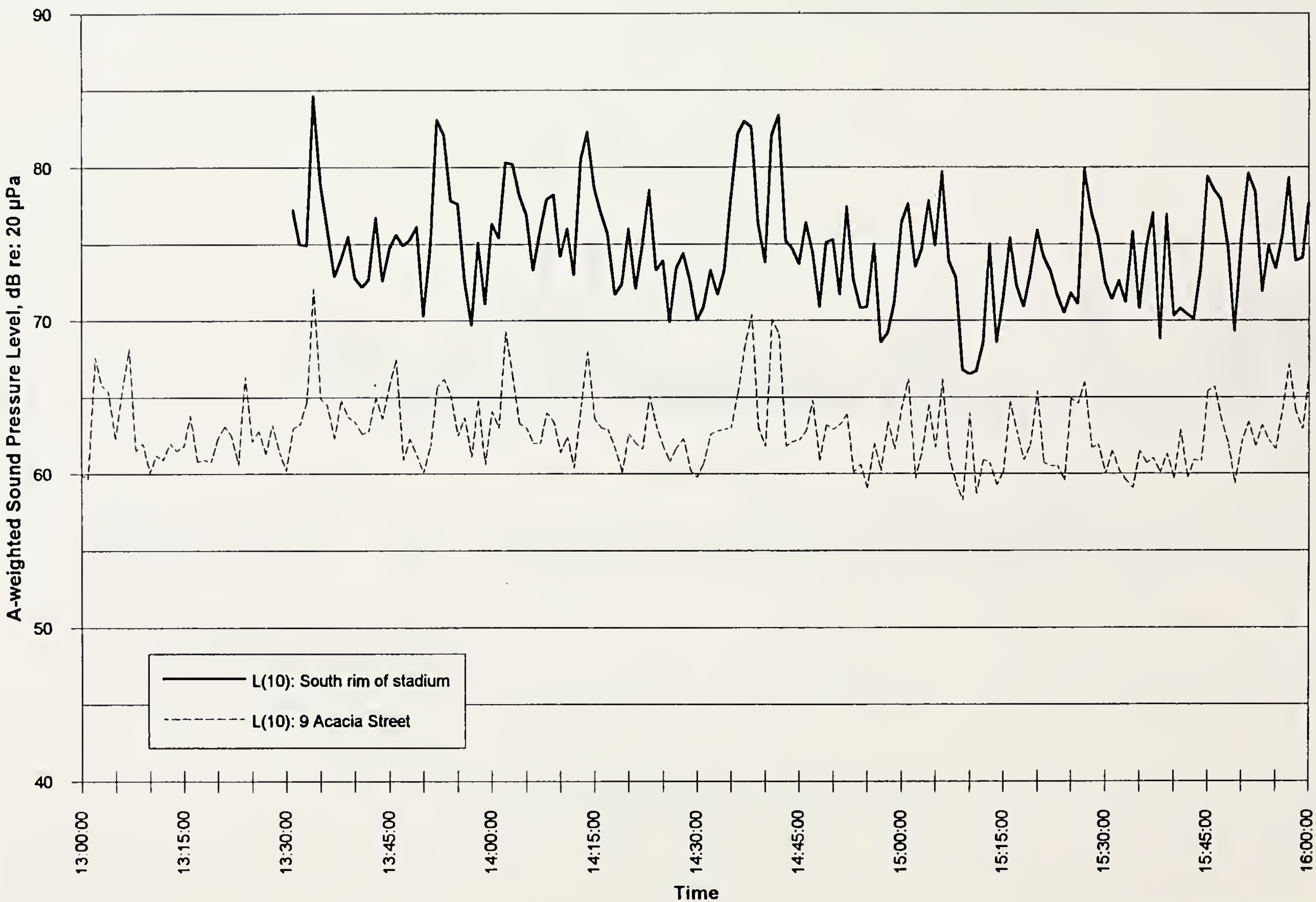
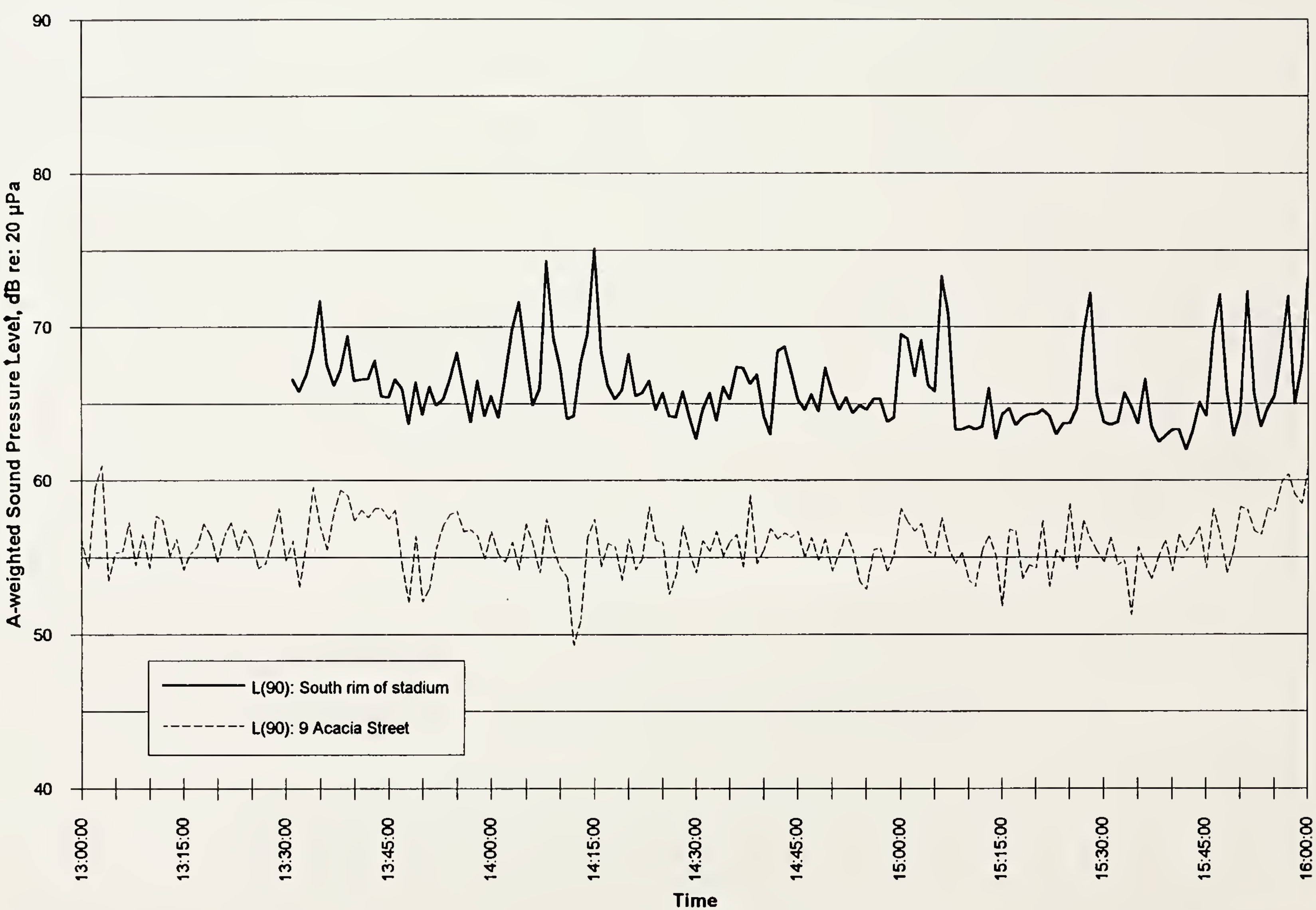


Figure 4
BC vs. Tulane, at BC -- 30 October 93
Comparison of Stadium vs. Community Noise: Measured L(90) Levels



AN ASSESSMENT OF PEDESTRIAN LEVEL WINDS FOR THE PROPOSED ALUMNI STADIUM ADDITION AT BOSTON COLLEGE

Prepared for:

RIZZO ASSOCIATES, INC.
235 WEST CENTRAL STREET
NATICK, MASSACHUSETTS 01760

Prepared by:

FRANK H. DURGIN, P.E.

DECEMBER 9, 1993

AN ASSESSMENT OF PEDESTRIAN LEVEL WINDS FOR THE PROPOSED ALUMNI STADIUM ADDITION AT BOSTON COLLEGE

BY FRANK H. DURGIN

1.0 INTRODUCTION

An assessment has been completed to determine the effect of the proposed Alumni Stadium Addition project on pedestrian level winds (PLWs) in and near the Stadium.

This assessment considers PLWs for existing conditions and the potential effects of the project on those PLWs. This assessment is based on:

1. The following maps and drawings:

    a. An enlarged copy of a U.S. geological and topographic survey map obtained from Rizzo Associates;

    b. Drawings of the existing and renovated Stadium obtained from ARC;

2. Two site visits;

3. Many photographs of the existing sites taken during the site visits;

4. Additional photographs taken of models of the proposed Alumni Stadium Addition at Boston College and at ARC;

5. Copies of the Environmental Notification forms for the parking garage now under construction northeast of O'Neill Library and the Physical Facilities Development Plan given to the MEPA Unit;

6. A copy of the Special Procedure for the Environmental Review Process issued by MEPA for the Physical Facilities Plan;

7. The Scoping Determination for the renovated Stadium issued by the BRA;

8. A copy of the Draft Project Impact Report for the renovated Stadium submitted to the BRA;

9. An evaluation of the urban context of the proposed project site;

10. A review of the Boston wind climate; and

11. The author's 25 years of experience dealing with PLWs.

The interaction of the wind with buildings and structures is very complicated and, at times, difficult to predict, especially for sites such as this, that are surrounded by hills taller than most of the buildings. Thus this study must be considered as a qualitative assessment only.

2.0 LOCATION AND DESCRIPTION OF THE PROJECTS AND SURROUNDING AREA (Figures 1a, 1b, and 2)

2.1 LOCATION AND DESCRIPTION OF THE PROJECT

Alumni Stadium is located on the Chestnut Hill Campus of Boston College, just off Beacon Street. The football field runs roughly north and south. Currently, both the east and west sides of the Stadium have two tiers of grandstands. The south end is enclosed by a semicircular one-tier grandstand. The north end of the Stadium is open. There is a parking garage partially under the east side of the Stadium and beyond that a large practice playing field between the garage and Chestnut Hill Drive. The Conte Forum connects to the Stadium on its west side and occupies nearly all the space between the Stadium and where the land rises sharply in a bank about 65 feet in height. The Stadium is in a valley so that most of the Stadium is below the bank. The top of the existing grand stands at the south end is about the same level as Beacon Street.

The renovations include removing the track, replacing all of the seats in the lower tiers of the east and west sides of the Stadium, and tearing down the semicircular grandstand at the south end of the Stadium. The south grandstand will be replaced with one that runs straight across the south end with short 45 degree angle sections connecting the new stand to the lower tiers of the existing east and west grandstands. There will be a second rectangular tier added to the grandstand at the south end of the Stadium. A similar grandstand will be built enclosing the north end of the Stadium with a second tier nearly identical to that at the south end.

The 65-foot bank to the west of Conte Forum runs slightly east of north beyond the Forum with O'Neill Library at its top.

Figure 1a shows contours of constant height about the campus, and Figure 1b shows the campus with the existing conditions. Figure 2 indicates build conditions.

2.2 THE SURROUNDING AREA

The surrounding area contains a mix of two- to seven-story buildings. The situation is complicated further by the fact that many of these buildings are half way up or on top of the

bank that surrounds much of the lower campus. For much of its length the bank is as high or higher than most of the buildings below. Behind the Conte Forum the bank extends north beyond O'Neill Library and the parking garage under construction north of the Library. There is a seven-story dormitory (Ignatio Hall) half way up the bank north of the garage and three others further up (Hillside B, C, and D). Beyond there the bank turns east, gradually decreasing in height, and then turns south and ends just before the MDC park. However, there is a small 10- to 20-foot hill covered with trees in the middle of the east end of the park. The bank also extends south of the Conte Forum. It then turns west along Beacon Street and eventually joins the base of Chestnut Hill. The bank surrounds the Lower Campus except to the northeast and east of the Stadium. Over most of its length there are five- to seven-story dormitories so the Lower Campus is quite sheltered from all but easterly winds. The Chestnut Hill Reservoir is to the east of campus. Thus it is quite open to the east of the Stadium.

The Middle Campus mostly contains two- to four-story buildings and parking lots. These buildings offer little sheltering to the Stadium. The bank and the buildings on or near its top along with Chestnut Hill to the south shelter the whole Lower Campus from all but easterly winds.

3.0 THE WIND CLIMATE

3.1 THE VARIATION OF WIND SPEED WITH HEIGHT (Figure 3)

In general, the natural wind is unsteady (i.e., it is gusty) and its average speed increases with height above the ground. Figure 3 depicts approximately how the average wind speed varies with height for different types of terrain. When one puts up any building, the possibility exists that the building will bring the higher speed winds at the top of the building down to ground level.

Monolithic buildings (i.e., those that do not change shape with height), if they are significantly taller than most of the surrounding buildings, almost invariably will be windy at their base. However, when there are many buildings of similar height in the area, they tend to shelter one another.

As noted above, the Stadium site and the Lower Campus is surrounded on three sides by the bank topped with buildings five to seven stories high. Thus, the site is sheltered and not windy now.

3.2 STATISTICAL DESCRIPTION OF THE BOSTON WIND CLIMATE

The project site is located about 6.5 miles west-southwesterly of Logan Airfield. Thus, the wind data from Logan Airfield that is usually used to define the winds for Boston is

applicable. Figure 4 depicts a wind rose for Boston. As noted in the figure, the wind rose is based on surface wind data from Logan Airfield taken from 1945 to 1965. While data from 1965 to 1992 is also available, it is not believed to be as representative of the true winds in Boston, due to the many 25 to 40 story buildings that have been built in the financial district of Boston since 1965. The financial district is just one mile west of Logan Airfield. The length of each line radiating from the center of the figure to the outermost crossing line is proportional to the total time the wind comes from that direction. The other lines crossing the radial lines indicate the frequency of winds less than 7.5, 12, and 19 mph.

Figure 4 shows that the winds in Boston come primarily from the northwest, west, and southwest. Figures 5 through 8 show wind roses for Boston for winter (December, January, and February), spring (March, April, and May), summer (June, July, and August), and fall (September, October, and November). These figures show that northwest winds tend to occur during the colder months and southwest winds during the warmer months. Spring and fall are transitional, but winds in the spring are stronger than those in the fall. Strong easterly winds usually occur during storms when there is precipitation.

The average wind speed at Logan Airfield at 58 feet (the average height at which the data was taken) is 12.9 mph. At pedestrian height (i.e., at chest height, 4.5 feet) it is about 8 mph. The average wind speed at 58 feet at Logan Airfield for each month is shown in Figure 9. Seasonally the average is 14.2 mph in the winter, 13.9 in the spring, 11.2 in the summer, and 12.3 in the fall. The fastest hourly wind for a 100-hour return period, however, is slightly faster in the spring than in the winter.

For the most part the weather in New England is dominated by either large coastal storms (fall, winter, and spring) or the Bermuda High (summer). Typically, when a coastal storm occurs, it rains or snows for 4 to 12 hours, then it clears, and, as the storm moves to the northeast, the winds blow from the northwest for three or four days until the next weather system arrives. These storms and the northwest winds following them occur mostly in the fall, winter, and spring. Northwest winds are particularly uncomfortable in the winter, when typically they occur on cold days. The Bermuda High is generally responsible for the southwest winds that occur in the summer.

4.0 CRITERIA

In the early 1980s, the city of Boston established a guideline criterion for acceptable winds that is still in use. The criteria states that if the effective gust at a location exceeds 31 mph more often than once in one hundred hours, the winds at that location are unacceptable. The effective gust is defined as the average wind speed plus 1.5 times the root mean square (rms) variation about the average and can be thought as a one minute gust. When many stations are considered the effective gust averages 1.38 times the average wind speed. That ratio enables

one to convert the BRA guideline effective gust wind speed of 31 mph to an average wind speed of 22.5 mph.

In 1978, Melbourne [2] developed probabilistic criteria for average PLWs that accounted for different types of pedestrian activity as well as the safety aspects of such winds (see Figure 10). He defined five categories of PLWs:

1. Dangerous and unacceptable;
2. Uncomfortable for walking;
3. Comfortable for walking;
4. Comfortable for short periods of standing and sitting;
5. Comfortable for long periods of standing or sitting.

These criteria are not absolute (any location can have dangerous winds in a hurricane); rather, they imply that the location would have wind speeds such that the activity suggested is possible most of the time, and would be perceived as such by most people who frequent the location. For example, the winds at pedestrian level at Logan Airfield are just in Category 2 (see Figure 10), uncomfortable for walking, and are just under the BRA 31 mph effective gust wind speed guideline (converted to an average wind). Therefore, most people would perceive conditions in the open at Logan Airfield as uncomfortable for walking.

In the discussion that follows, Melbourne Categories for specific wind directions will be given. Overall categories are less than or the same as the greatest of those for individual directions.

5.0 PEDESTRIAN LEVEL WINDS AT THE SITE

5.1 INTRODUCTION

In the following sections, the effects of northwest winter winds, southwest summer winds, and easterly storm winds will be discussed for existing and build conditions. The discussion will include considerations of PLWs on the sidewalks and at pedestrian entrances to Stadium. Unless otherwise noted, the renovated Stadium will not affect any entrances to other buildings.

5.2 NORTHWEST (WINTER) WINDS (FIGURES 11 AND 12)

5.2.1 Introduction

Northwest winds blow diagonally at the northwest corner of the new grandstand. Such winds, when they are at all strong, can be very uncomfortable on a cold wintry day. When there is a wind on a sunny late fall day it is most likely to come from the northwest.

5.2.2 Existing Conditions for Northwest Winds (Figure 11)

For existing conditions a northwest wind blows diagonally into the open North end of the Stadium. The open set of stairs to the west grandstand at its north end is probably quite windy particularly near the top. The east grandstand and the southeast corner of the curved stands at the south end of the Stadium are also probably quite windy. The west grandstand and the entrances to it at the north end and through the Conte Forum are in the wake of the bank and of the buildings at and near the top of the bank (Melbourne Category 4 or 5). All the entrances to the Stadium at its south end are in the wake of the Stadium or the Conte Forum and the bank with its many buildings near its top. Thus, those entrances are quite sheltered (Melbourne Category 5).

5.2.3 Build Conditions for Northwest Winds (Figure 12)

For build conditions and northwest wind, PLWs at the entrances at south end of the Stadium will be the same as now or improved due to the added height of the grandstands at that end (Melbourne Category 5). The windiness in the east grandstands and near the southeast end of the lower stands at the south end of the Stadium will be about the same as it is now (Melbourne Category 3 or 4). There will be a tendency for the wind to be funneled down into the lower diagonal grandstands at the southeast corner of the Stadium. However, the ten foot wall at the top of the stands will probably force most of that wind above the heads of the fans. The new upper stands at the south end will be windier than the lower ones because of their added height (Melbourne Category 4).

The windiness in the west grandstands will be unaffected by the renovations. The new grandstands at the north end will provide shelter for the people in them (Melbourne Category 5). If, as shown in the drawings, the gap between the upper and lower stands is left open, northwest winds will be funneled under the upper stands on to the backs of those in the upper part of the lower stands (Melbourne Category 4). The stairs and elevators to the upper stands at the northwest and northeast corners of the new grandstands will be windy (Melbourne Category 3 or 4), were they not enclosed. On the other hand, because of the relative openness of the stands at ground level on the outside of the Stadium, the entrances along that north end will probably not be very windy when the wind is from the NW (Melbourne Category 4).

The North entrance to the Conte Forum and the pedestrian entrances to the garage under construction north of the Conte Forum will remain sheltered from northwest winds by the 65-foot bank and O'Neill Library.

5.3 SOUTHWEST (SUMMER) WINDS

5.3.1 General

The prevailing winds in the summer are from the southwest. Southwest winds blow diagonally at the west side of the Stadium. Southwest winds will not occur as often as northwest winds during the football season.

5.3.2 Existing Conditions in Southwest Winds (Figure 13)

There are several five to seven story buildings on a southerly extension of the bank to the west of the Conte Forum. That extension wraps around the Stadium. It then becomes parallel with Beacon Street and joins the base of Chestnut Hill. As already noted, Beacon Street is roughly at the same height as the top of the existing south Grandstand. Thus the whole south end of the Stadium is currently sheltered from southwest winds (Melbourne Category 5).

The west grandstand of the Stadium is shielded for these southwest winds by the Conte Forum and the back of the west grandstand (Melbourne Category 5). The only parts of the Stadium that are at all exposed to southwest winds are the north end of the east grandstand and rectangular open tower containing the stairs to the east grandstands (Melbourne Category 3 or 4).

The North entrance to the Conte Forum and the pedestrian entrances to the garage under construction north of the Forum will remain sheltered from southwest winds by the 65-foot bank and buildings on it to the southwest of the Forum.

5.3.3 Build Conditions for Southwest Winds (Figure 14)

For build conditions and a southwest wind, the grandstands at the south end of the Stadium will be sheltered by the back of the stands. The entrances to the south grandstands will still be sheltered by the bank and the buildings on the bank (Melbourne Category 5). Because all of the four new stair and elevator towers at the corners of the Stadium will be enclosed, they will not be windy. All the ground level entrances along the new north end grandstands will be sheltered by the Conte Forum or the new north grandstands (Melbourne Category 5). Southwest winds will tend to be funneled down onto the small diagonal grandstand at the northeast corner of the Stadium. As was the case for northwest winds at the southeast corner, the ten-foot wall at the back of the stands will tend to deflect these winds above the fans.

Also, the north entrance to the Conte Forum and the pedestrian entrances to the garage under construction north of Forum will continue to be sheltered from southwest winds.

5.4 EASTERLY STORM WINDS (Figures 15 to 20)

5.4.1 Introduction

Easterly winds occur about one third of the time. Light easterly winds occur as a storm starts or in the summer as a sea breeze. During the first 4 to 12 hours of a typical storm, it rains or snows depending on the temperature, and the wind is from the northeast or southeast depending on whether the center of the storm passes to the east or west of the city. The majority of storms pass to the east of the city so the northeast winds are the most prevalent.

Since for strong easterly winds, it will generally be raining or snowing, and people expect windiness, the emphasis in the following discussions will be on entering or exiting the Stadium. Also, because easterly winds cover such a wide range of wind directions, the discussion covers northeast, east, and southeast winds separately in that order. Storms with rain and or snow are not uncommon during the football season.

5.4.2 Existing Conditions for Northeast Winds (Figure 15)

Northeast winds blow directly at the northeast corner of the Stadium and diagonally at the bank that is parallel to the wets stands of the Stadium.

The east side and north end of the Stadium are quite exposed to northeast winds, and would be more so if there were not a small hill at the east end of the MDC park with a lot of trees on it. The south end entrances and stands are sheltered by the adjoining garage and entrance at its southeast end. The top of the east grandstand is sheltered from the northeast wind by the press boxes and lights above. The west grandstand would be more exposed than it is, if not for the lights and press boxes above it.

Currently the most exposed part of the Stadium to northeast winds is the set of ramps and stairs at the north end of the east grandstand (Melbourne Category 3).

Finally, because the northeast wind is trapped between the 65-foot bank and Conte Forum, the north entrance to the Forum is probably somewhat windy during northeast storms (Melbourne Category 4).

5.4.3 Build Conditions for Northeast Winds (Figure 16)

The change from circular to rectangular shape and the addition of the second tier of grandstands at the south end of the Stadium will have little effect on winds at the south end of the Stadium. Of course the southwest corner of the new tier will be windy as is the south end of the west grandstand (Melbourne Category 3 or 4). Winds in the east grandstand will be unaffected, and the new two-tiered north Grandstand will shelter most of the fans in it (Melbourne Category 5). While the northeast wind will be somewhat defused by the many

openings in the north Facade of the north Grandstand, winds will be fairly strong at the entrances along the north end of the Stadium (Melbourne Category 4). Northeast winds will tend to be funneled down onto the small diagonal grandstand at the southwest corner of the Stadium. As was the case for northwest winds at the southeast corner, the ten-foot wall at the back of the stands will tend to deflect these winds above the fans.

Winds at the north entrance to the Conte Forum will be increased due to the new grandstands at the north end of the Stadium (Melbourne Category 3).

5.4.4 Existing Conditions for East Winds (Figure 17)

East winds blow almost directly at the garage and the back side of the east grandstands. The garage, which extends south beyond the south end of the Stadium, and the tall entrance at that end, thus shelter all the entrances at the south end of the Stadium (Melbourne Category 4 or 5). The north end of the stadium would be quite windy for east winds were it not for the many trees on the small hill in the MDC park just east of it (Melbourne Category 5). Because it is higher than the trees, the open ramp and stairway to the upper tier of the east grandstands are probably quite windy during east winds (Melbourne Category 3).

Because the north entrance to the Conte Forum is shielded from east winds by the part of the Forum the juts out to the north between the Stadium and the Forum, it will not be windy (Melbourne Category 5).

5.4.5 Build Conditions for East Winds (Figure 18)

With the Stadium renovations in place, winds at the south end of the Stadium will remain calm (Melbourne Category 5). The new stairs and elevators at the four corners of the Stadium will be enclosed (Melbourne Category 5). The entrances to the north stands will have light winds (Melbourne Category 4 or 5).

The Alumni Stadium Addition will not affect the winds at the north entrance to the Conte Forum (Melbourne Category 5). There is a south entrance to forum, but it is so sheltered from all winds that winds there will always be in Melbourne Category 5.

5.4.6 Existing Conditions for Southeast Winds (Figure 19)

Southeast winds come across Chestnut Hill Reservoir and around Chestnut Hill. By the time they reach the campus, Chestnut Hill has turned them into east winds so all the discussion above also applies to southeast winds.

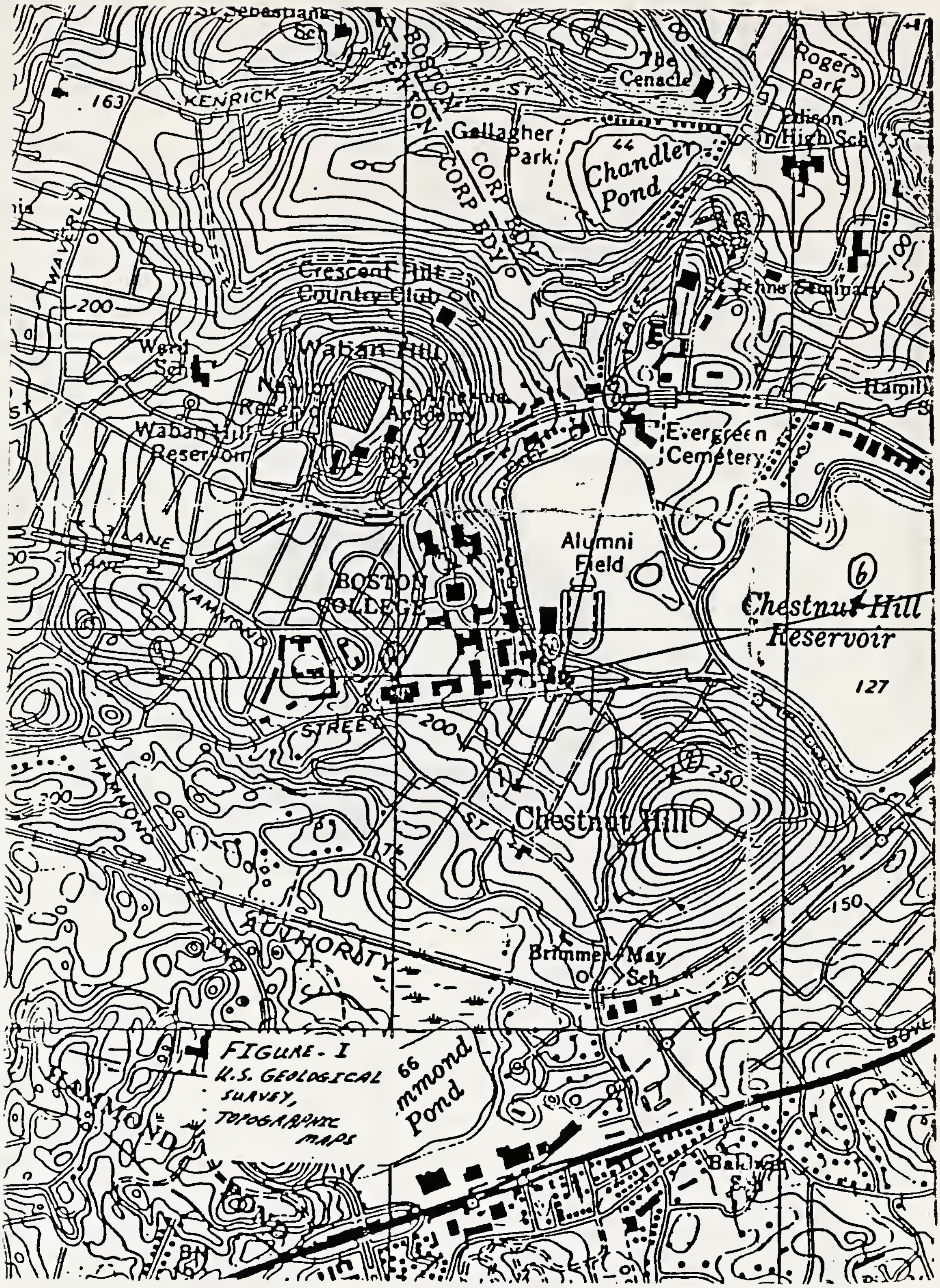


Figure 1a Contour Map of Area

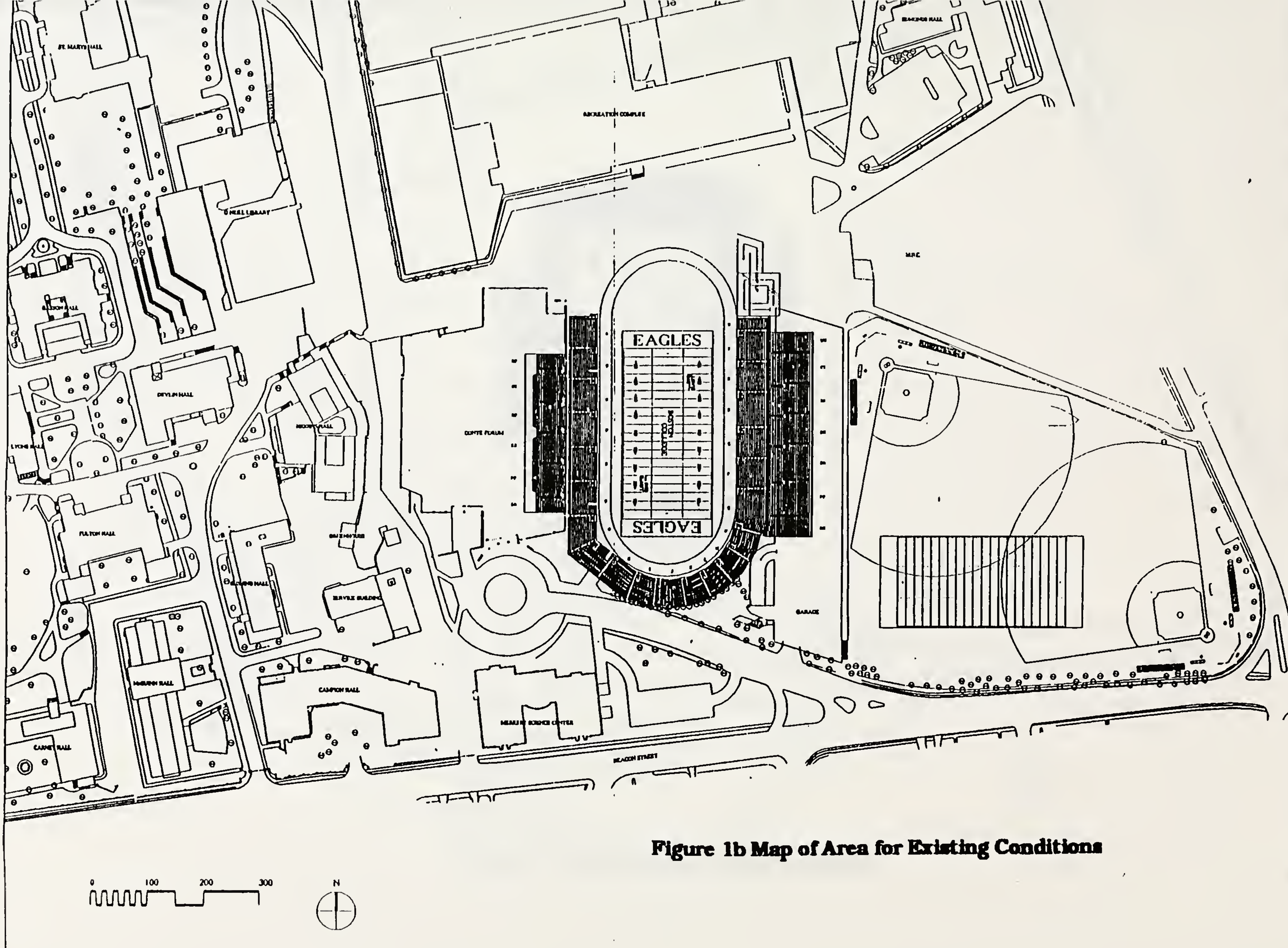


Figure 1b Map of Area for Existing Conditions

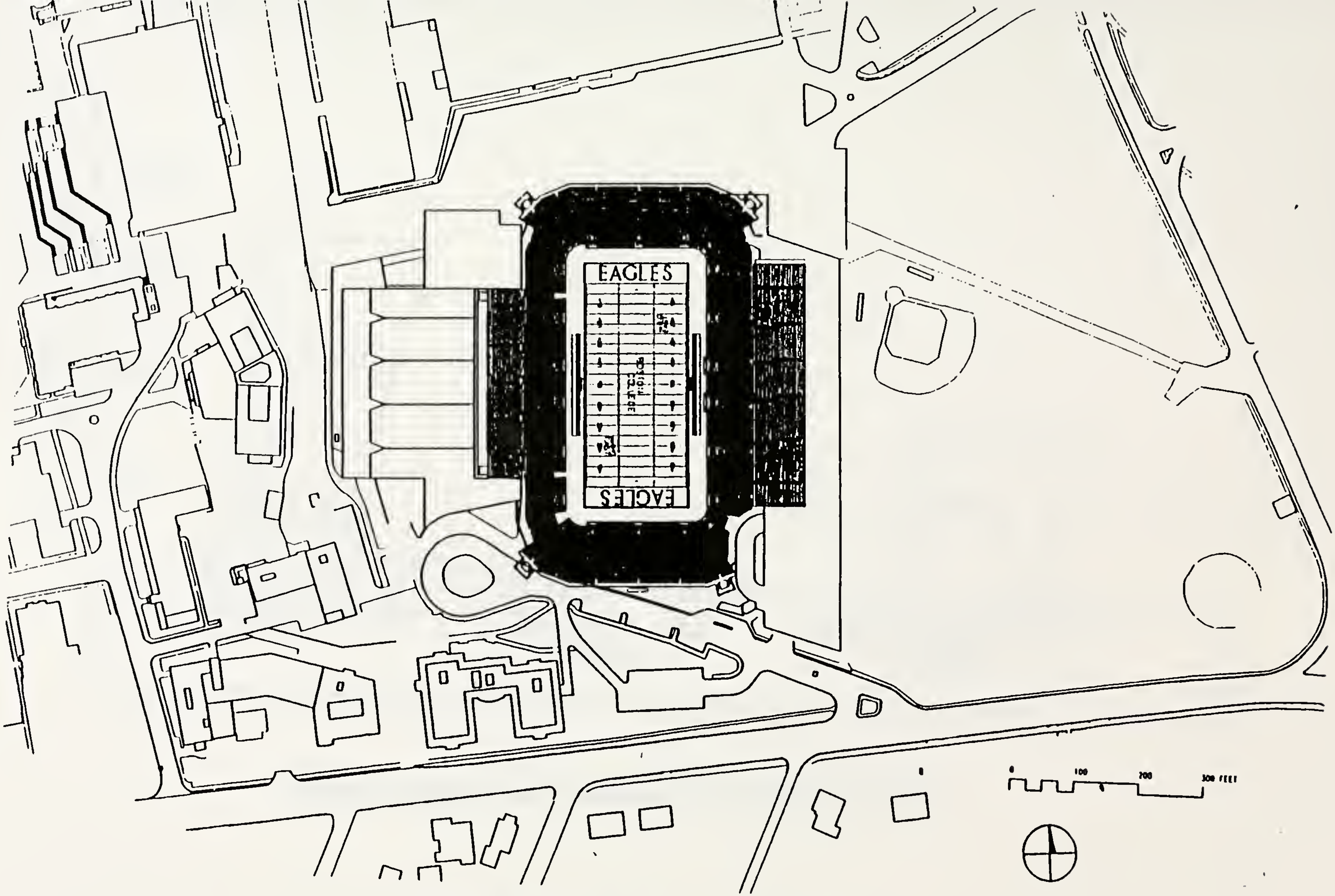


Figure 2 Map of Area for Build Conditions

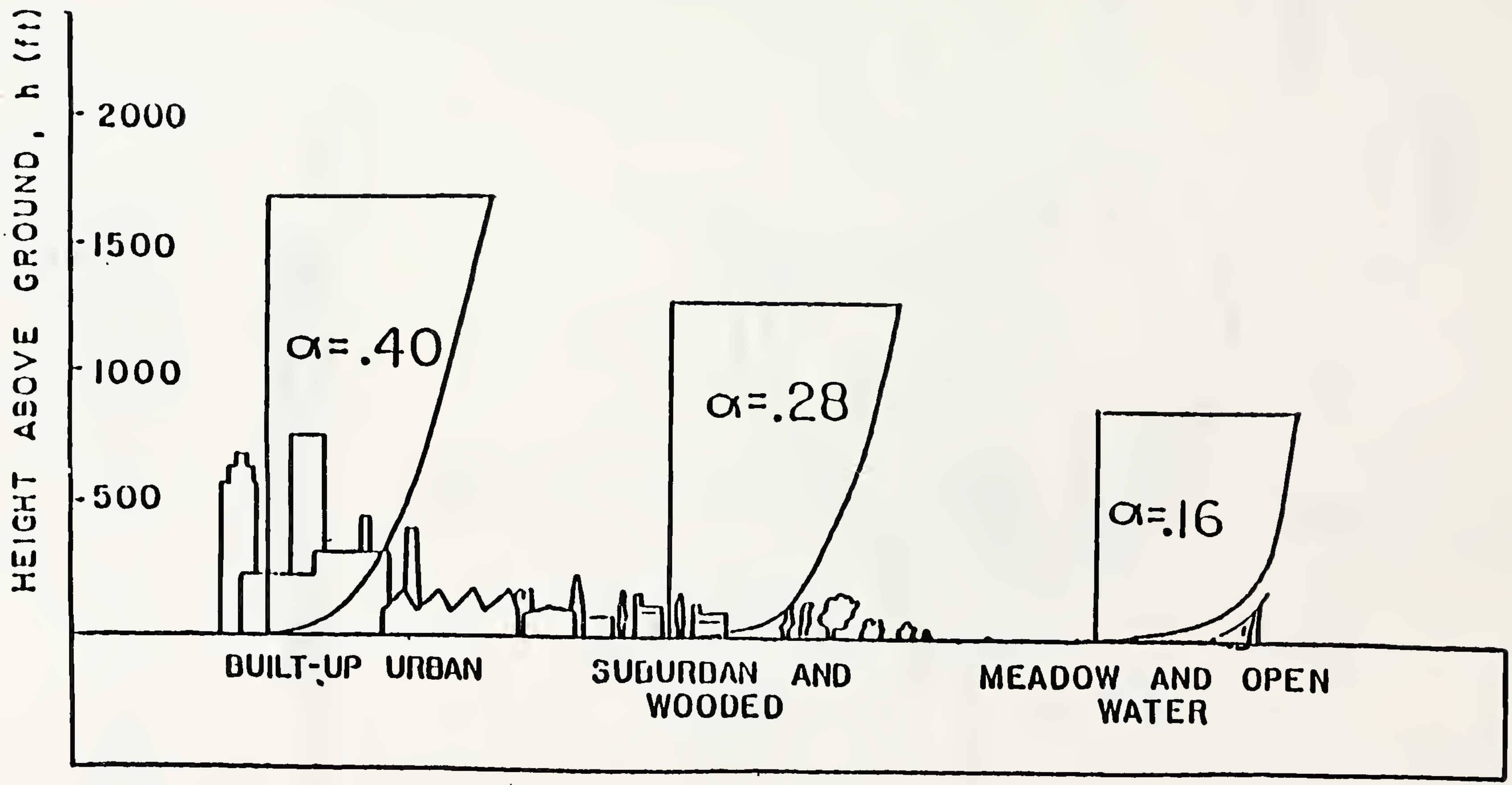


Figure 3 Types of Earth's Boundary Layer after Davenport [1]

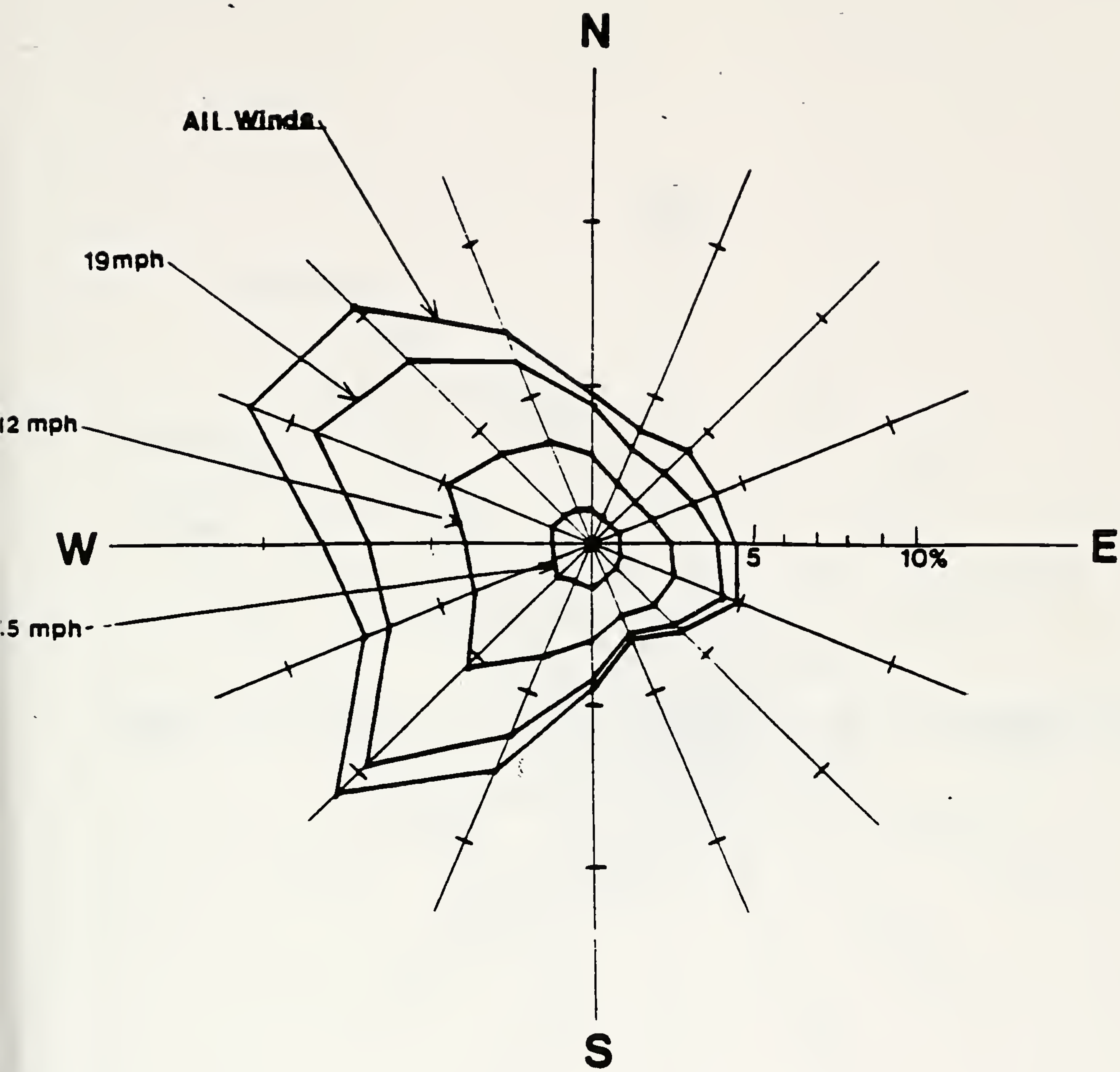


Figure 4 Annual Wind Rose for Boston Based on Surface Data from Logan Air Field 1945-1965

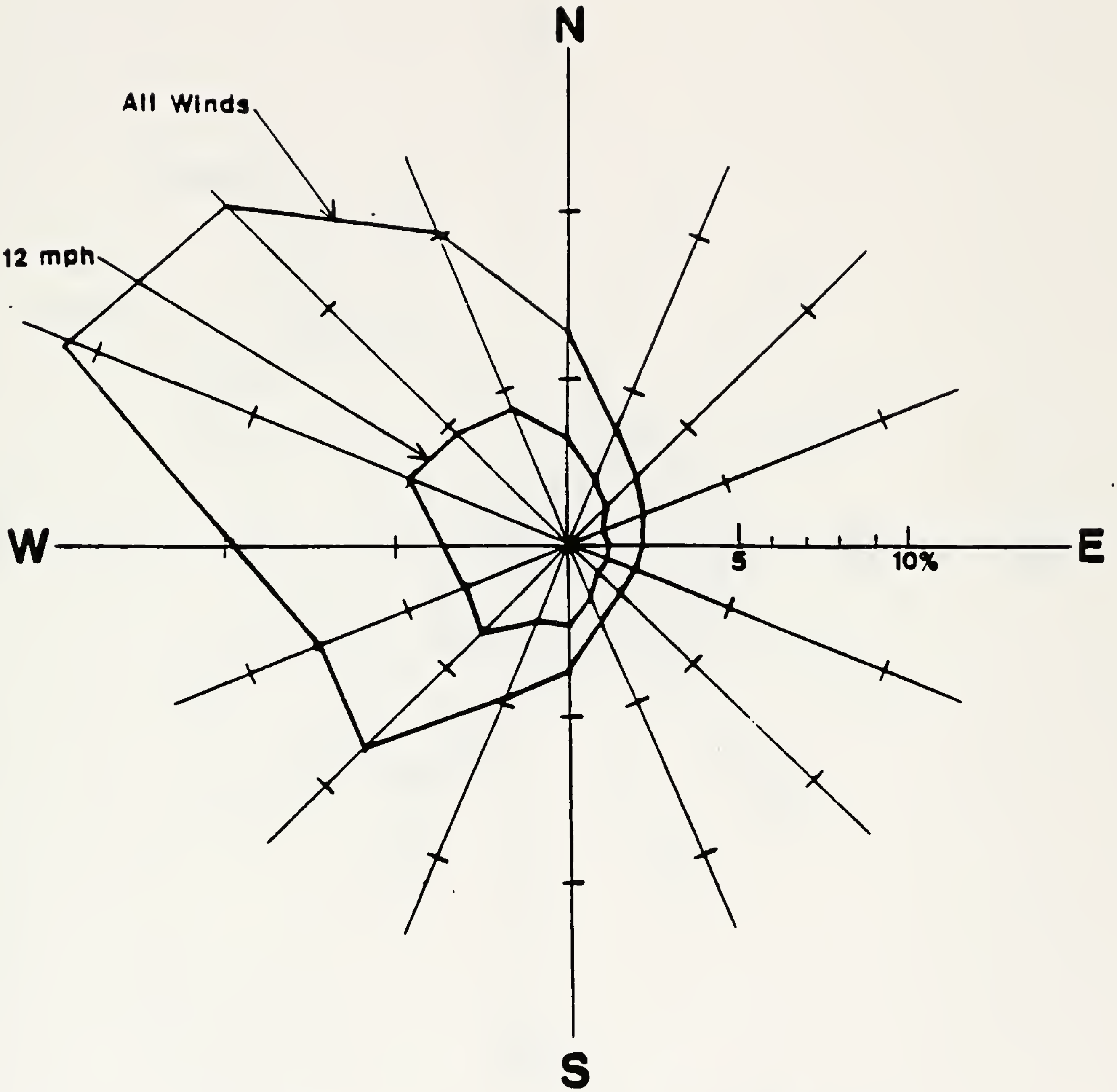


Figure 5 Winter (December, January, February) Wind Rose for Boston based on Surface Data from Logan Air Field 1945-1965

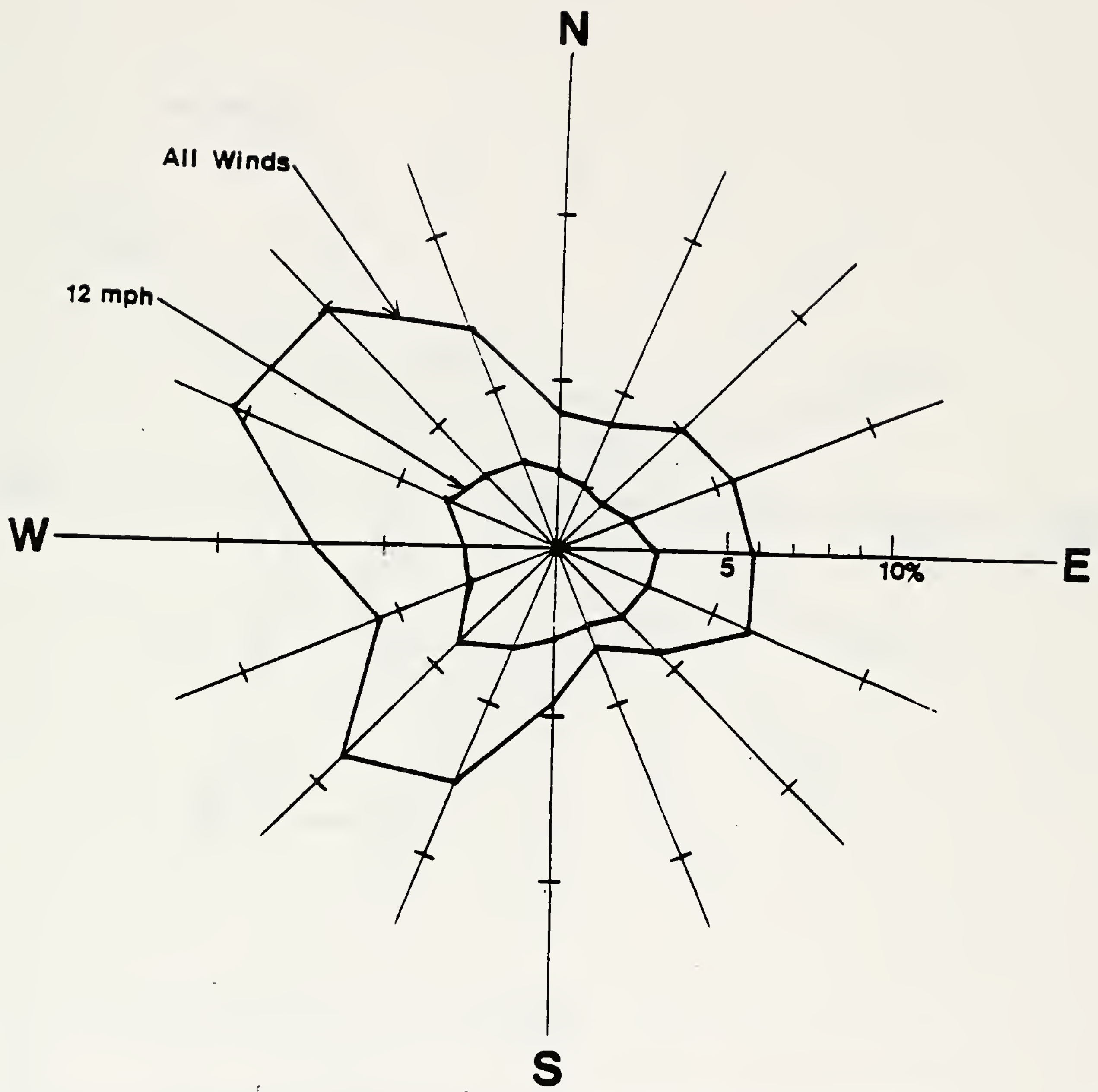


Figure 6 Spring (March, April, May) Wind Rose for Boston based on Surface Data from Logan Air Field 1945-1965

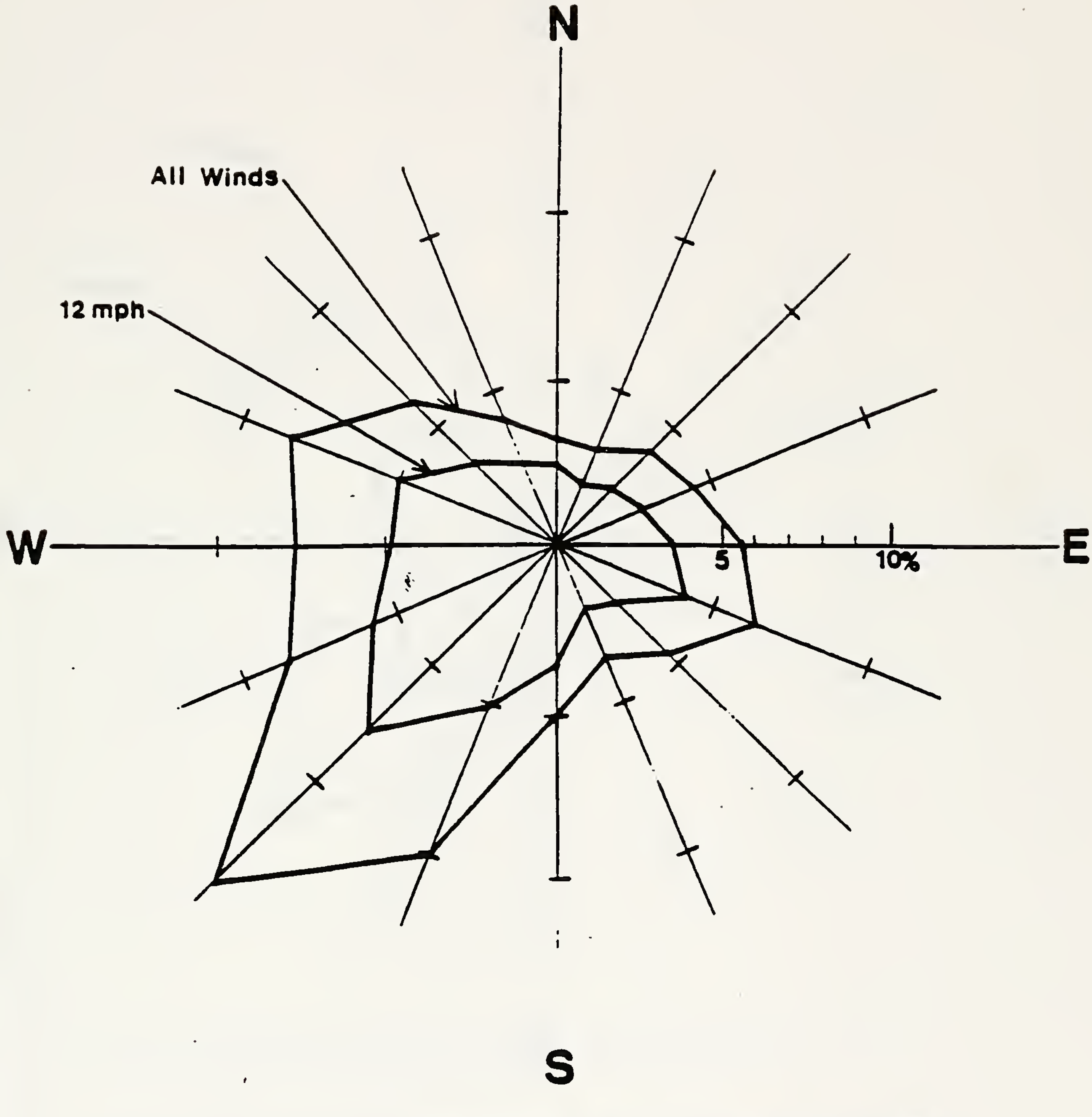


Figure 7 Summer (June, July, August) Wind Rose for Boston based on Surface Data from Logan Air Field 1945-1965

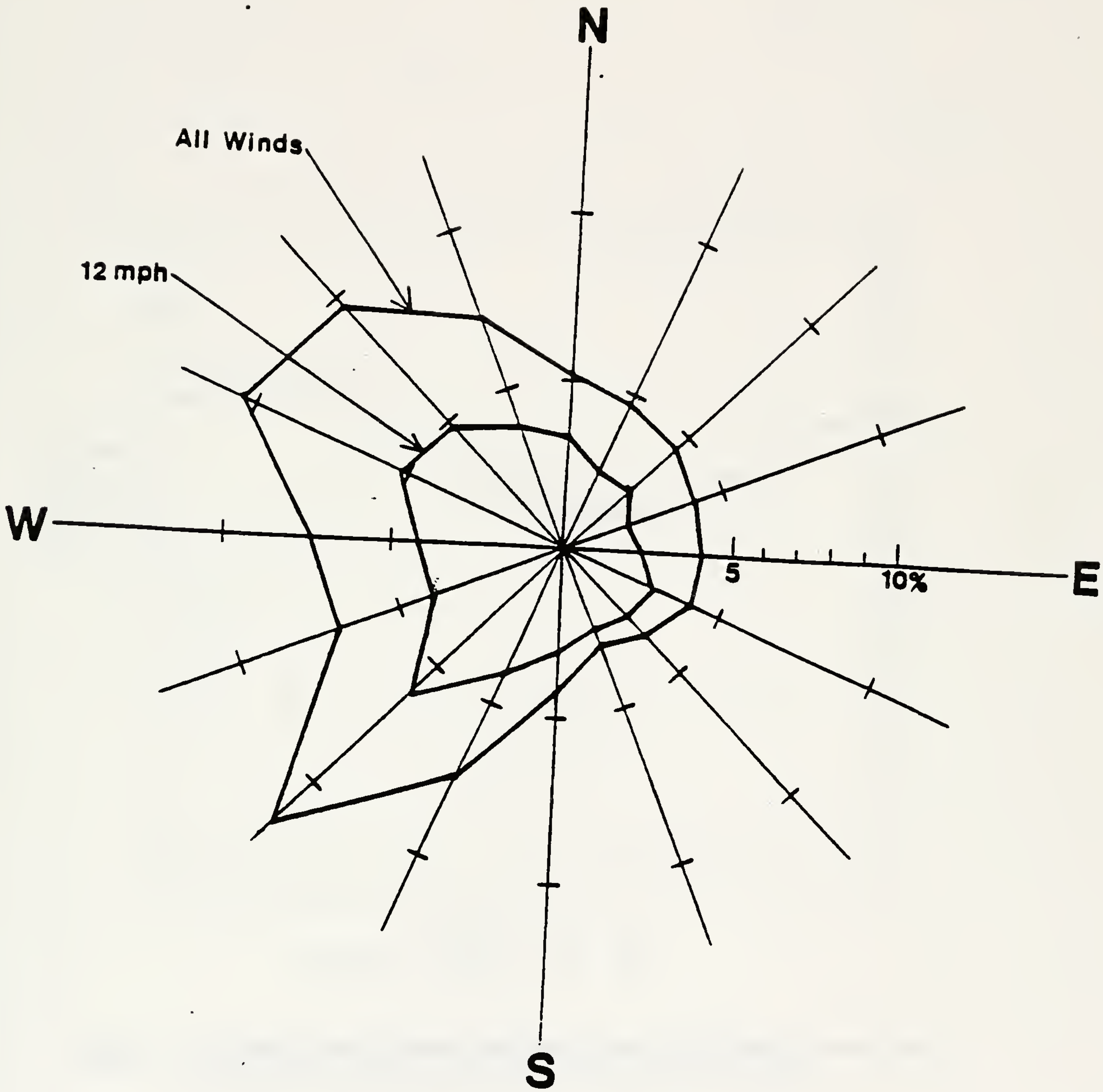


Figure 8 Fall (September, October, November) Wind Rose for Boston based on Surface Data from Logan Air Field 1945-1965

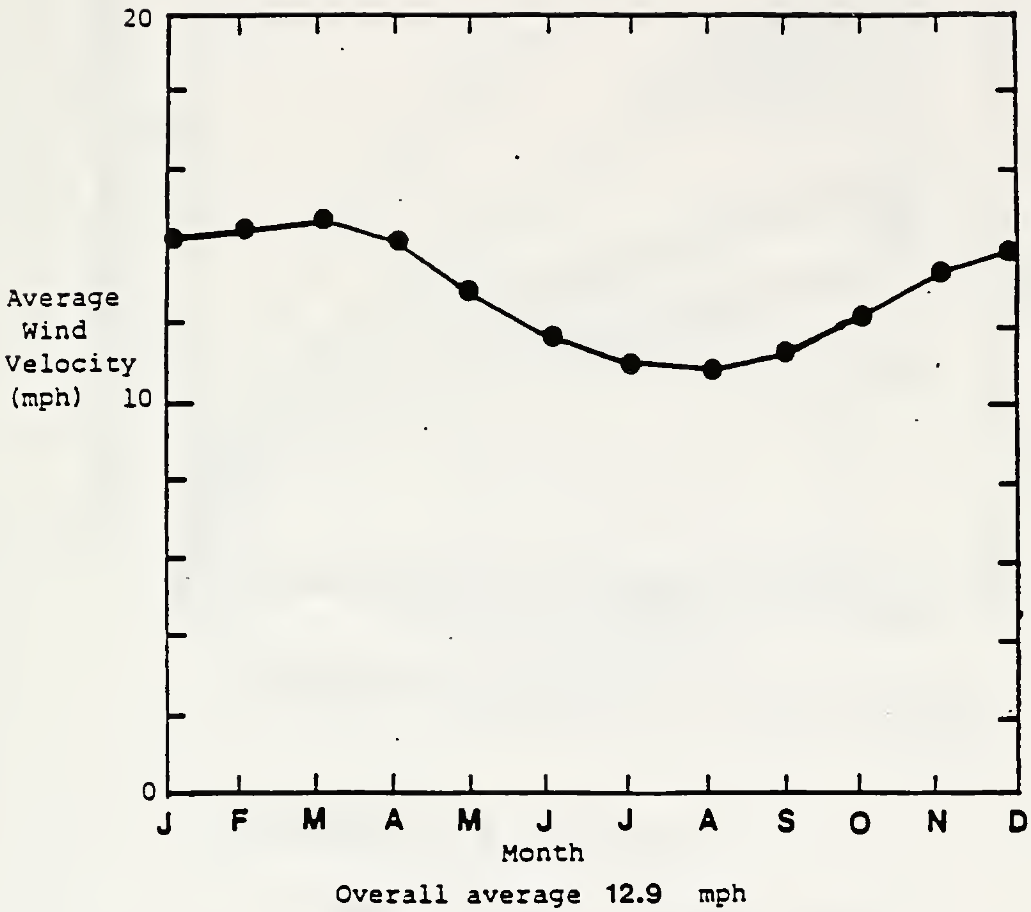
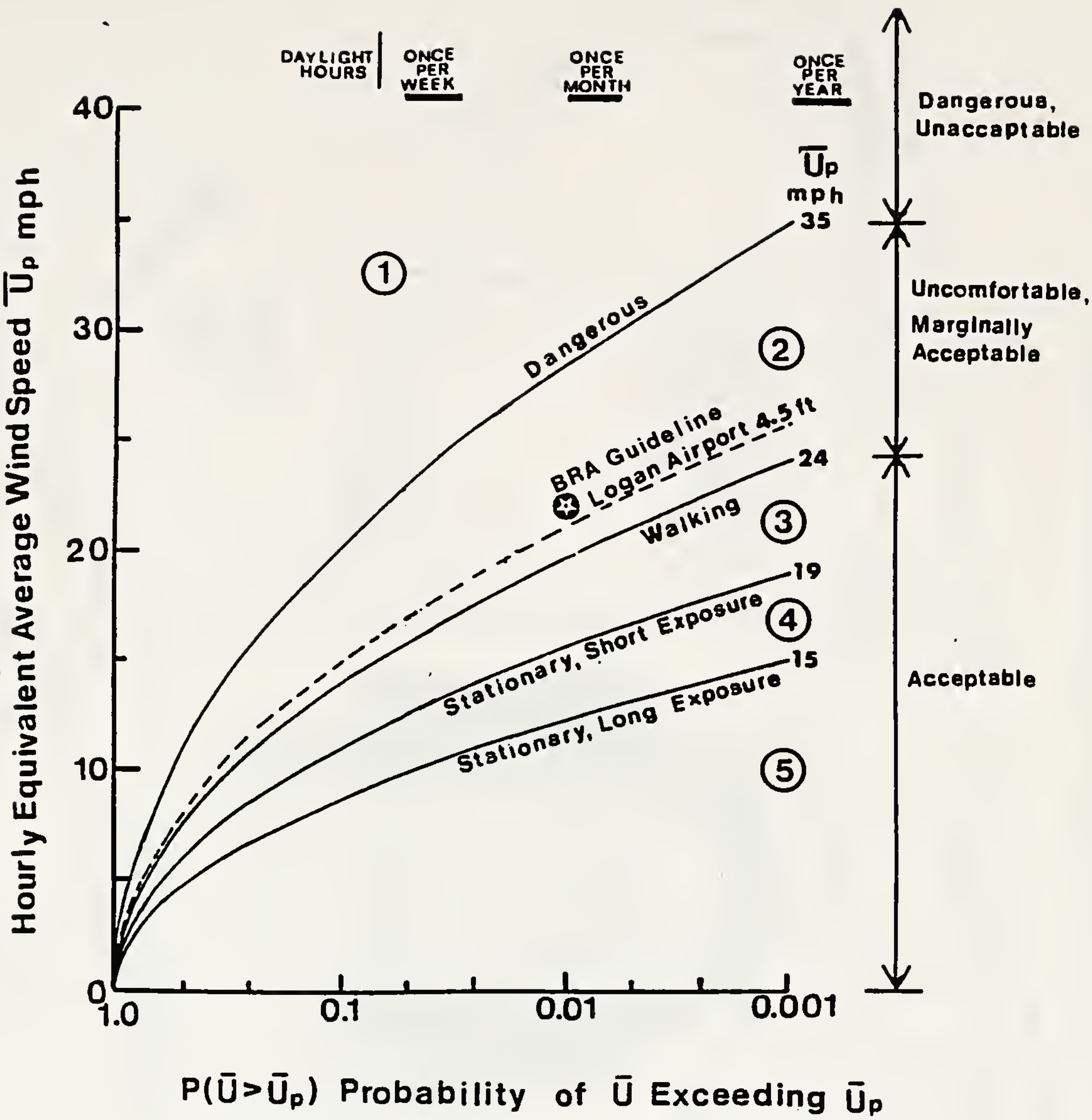


Figure 9 Average Wind Speed for Boston for each Month, based on Surface Data from Logan Air Field 1945-1965



◯ Melbourne's Category

1 Unacceptable and dangerous
2 Uncomfortable for walking
3 Acceptable for walking
4 Acceptable for short periods of standing or sitting
5 Acceptable for long periods of standing or sitting

Figure 10 Melbourne's Criteria for Hourly Mean Wind Speeds

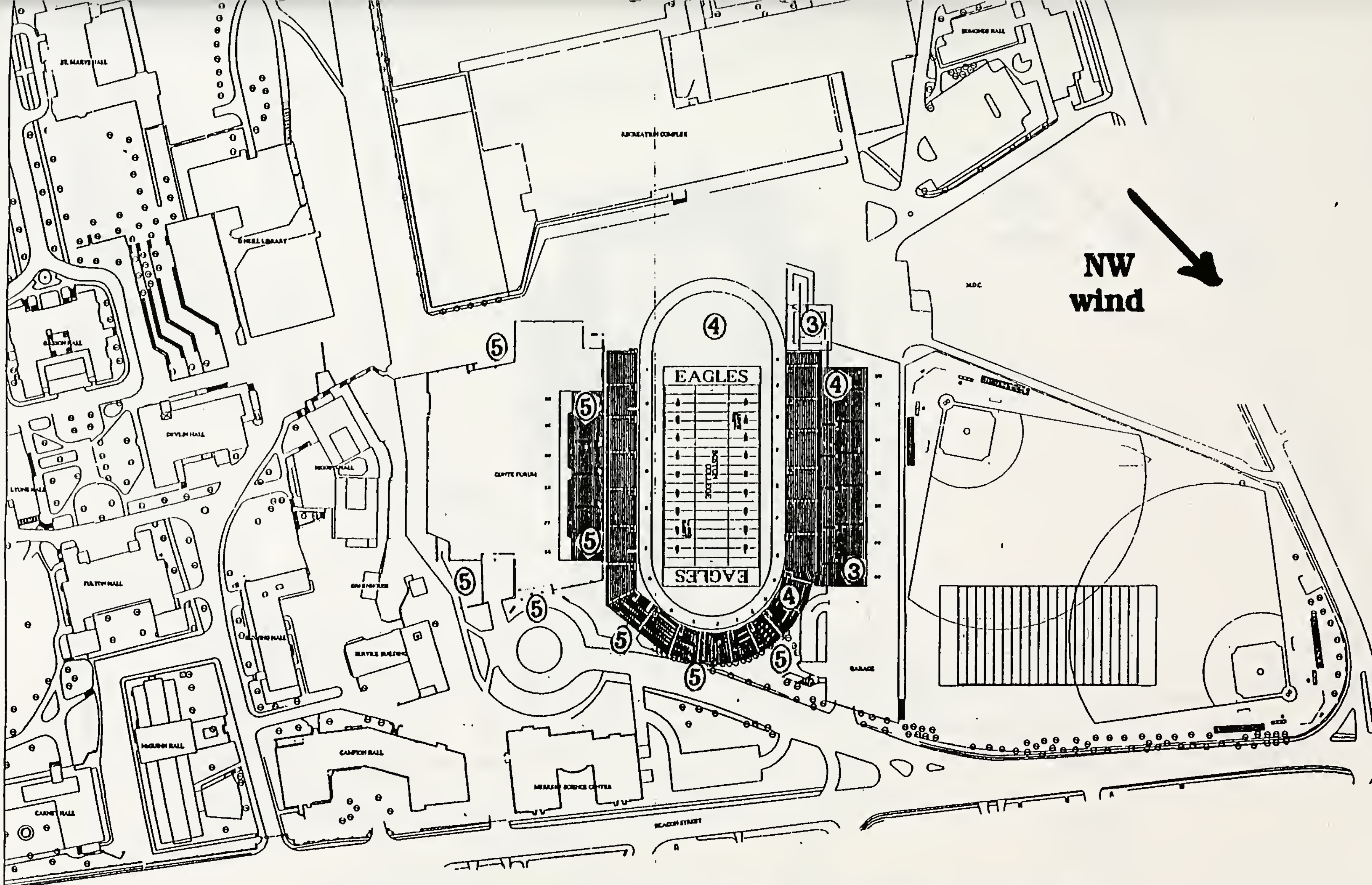


Figure 11 Melbourne Categories for Existing Conditions for NW Winds

0 100 200 300

N

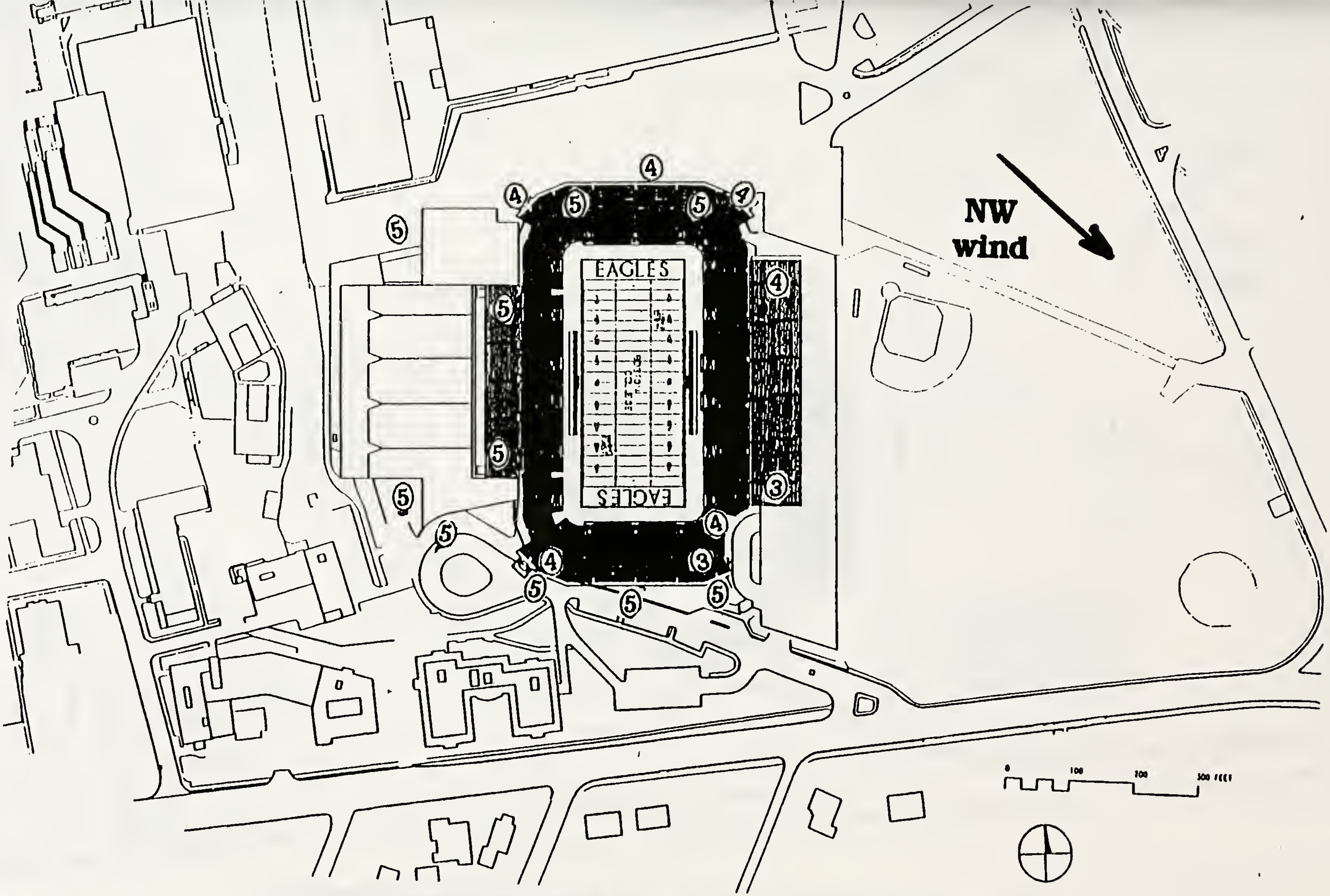


Figure 12 Melbourne Categories for Build Conditions for NW Winds

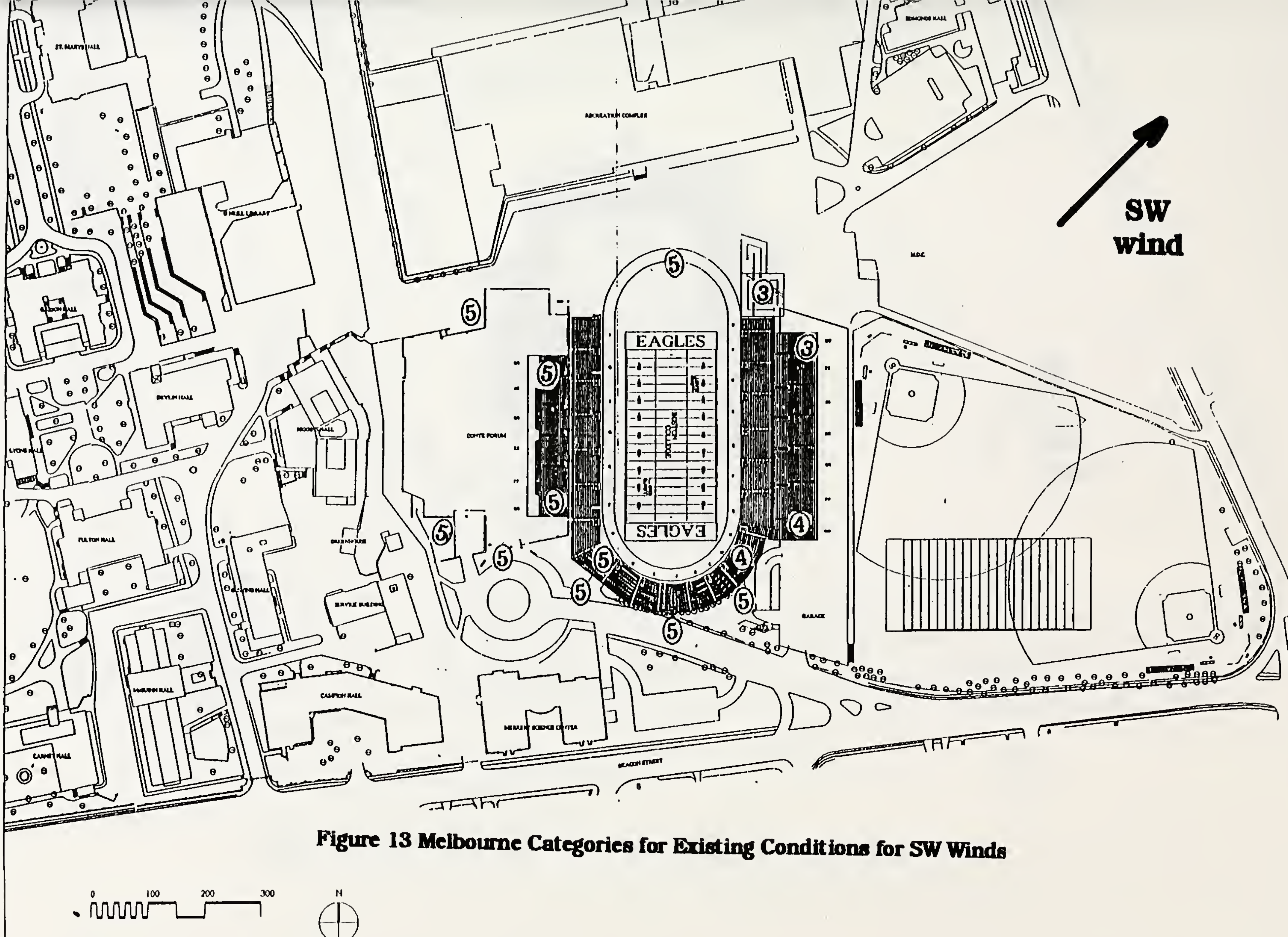


Figure 13 Melbourne Categories for Existing Conditions for SW Winds

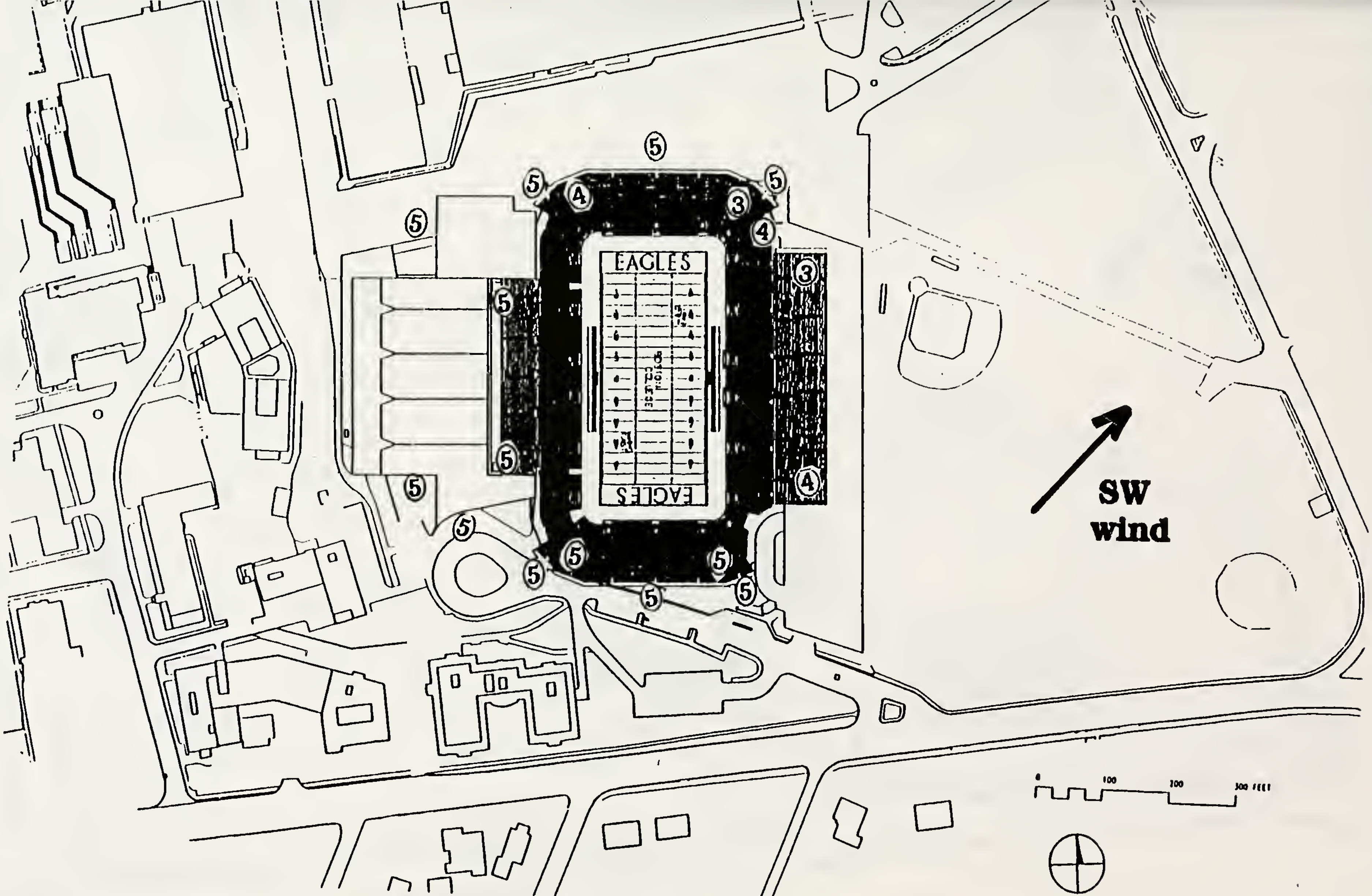


Figure 14 Melbourne Categories for Build Conditions for SW Winds

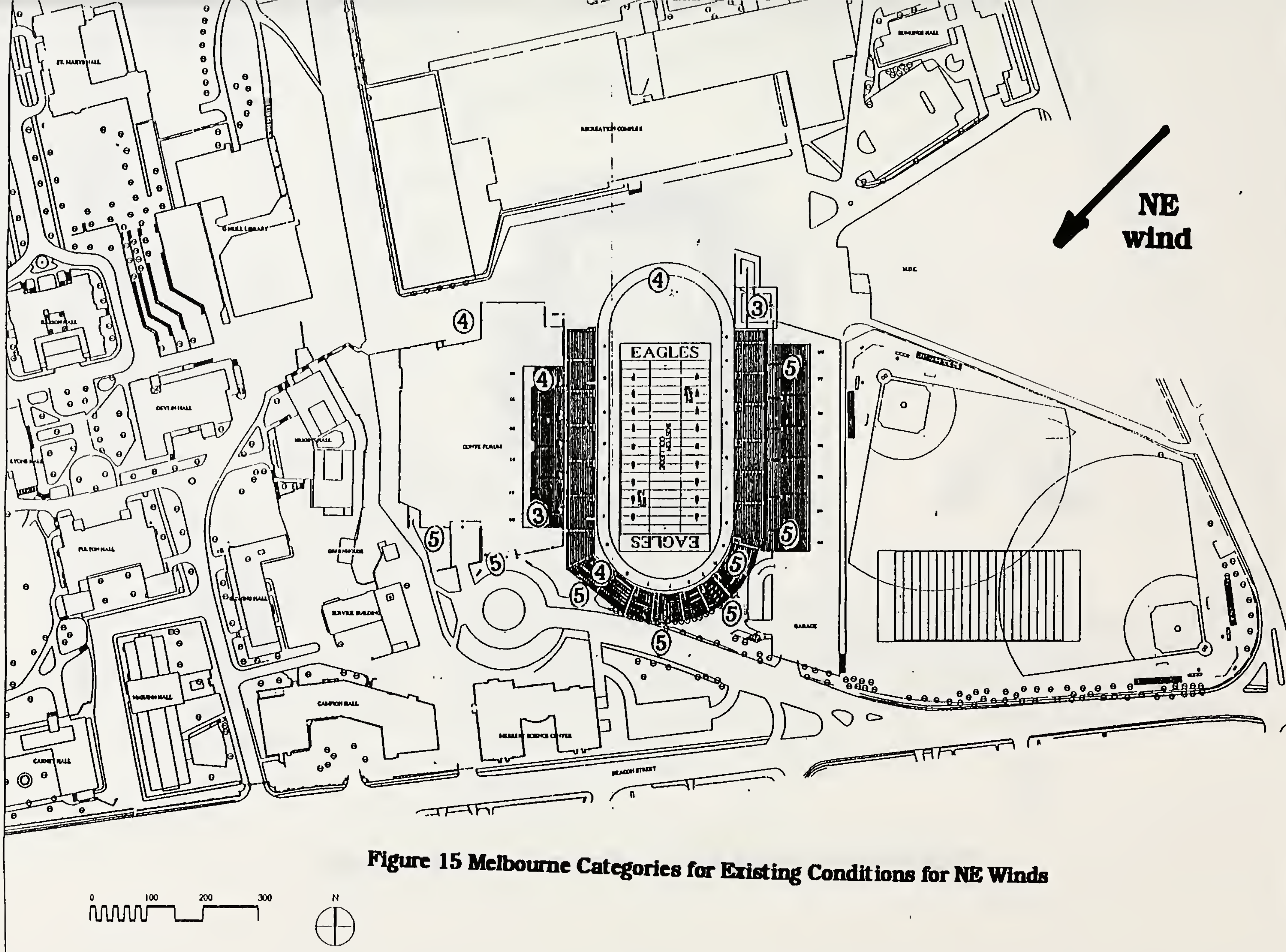


Figure 15 Melbourne Categories for Existing Conditions for NE Winds

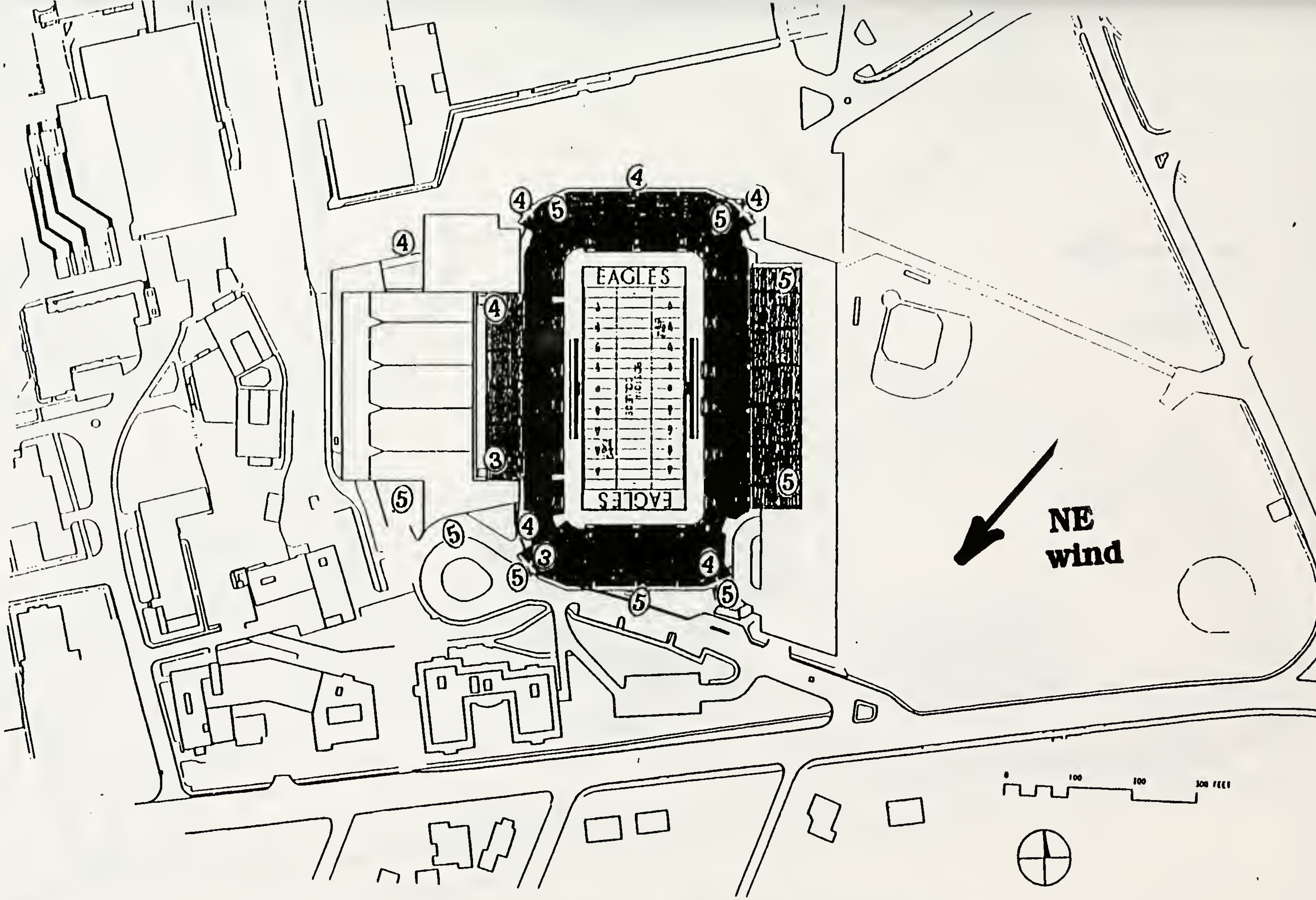


Figure 16 Melbourne Categories for Build Conditions for NE Winds

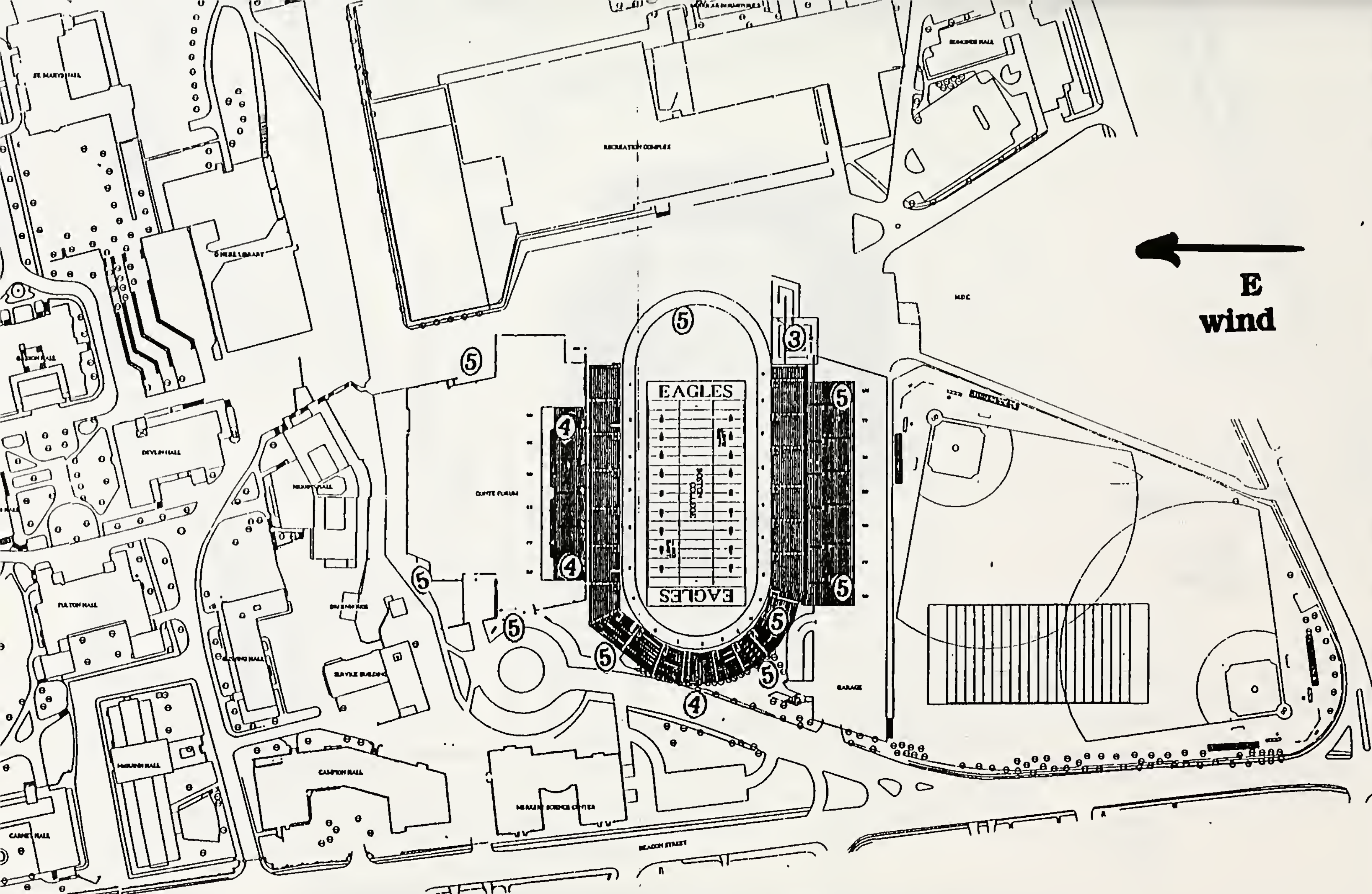
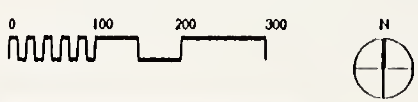


Figure 17 Melbourne Categories for Existing Conditions for E Winds



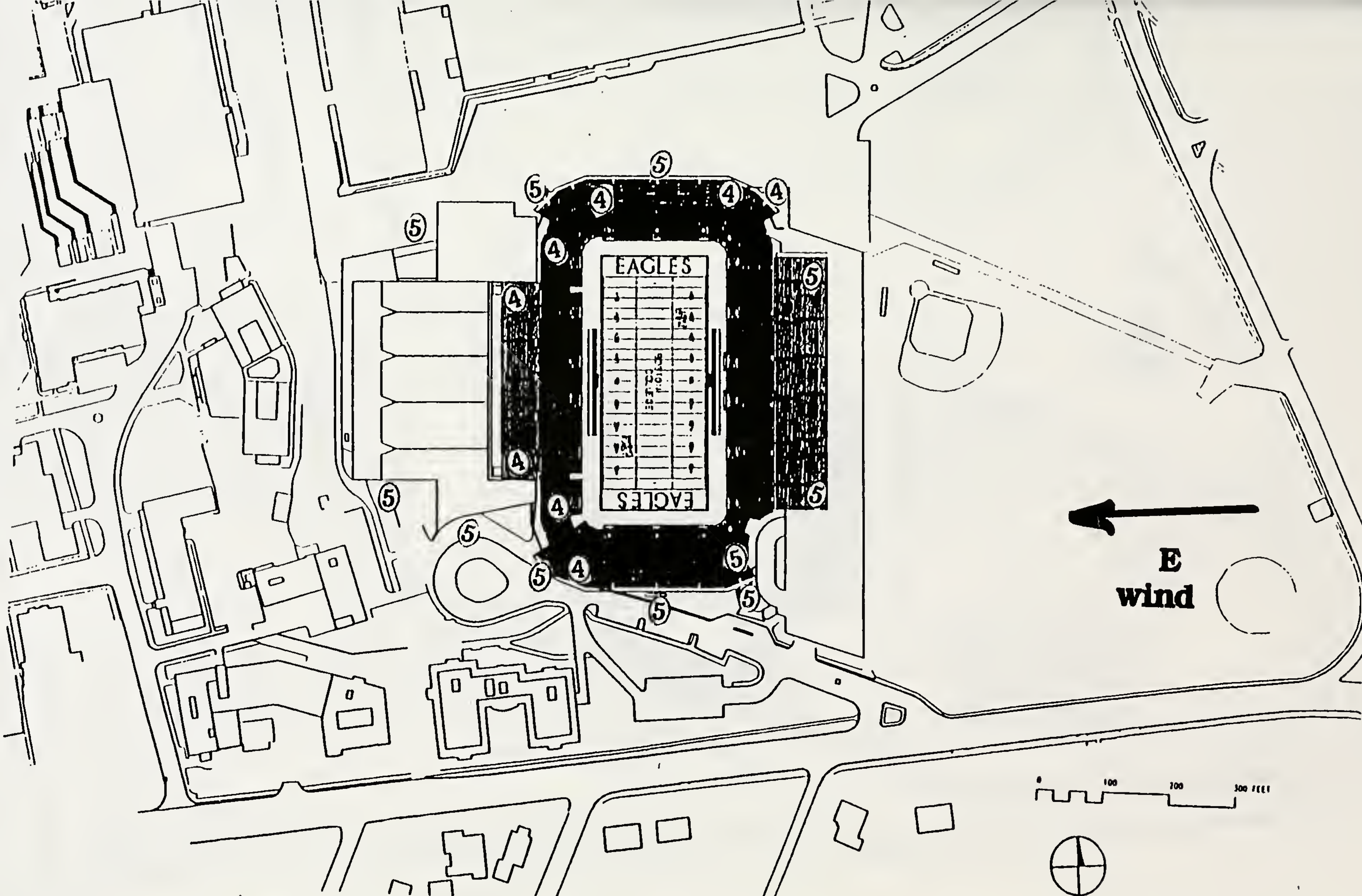


Figure 18 Melbourne Categories for Build Conditions for E Winds

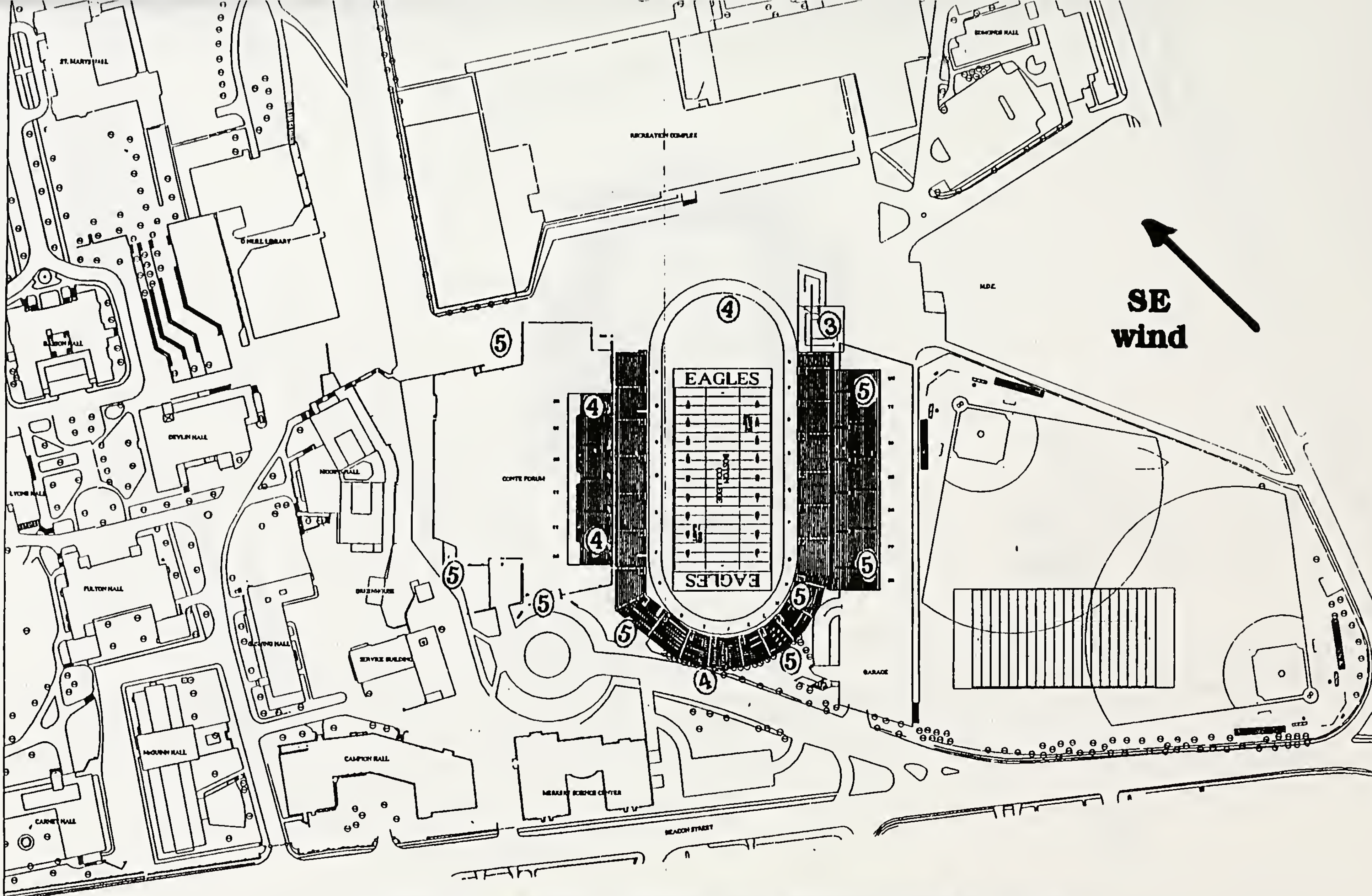
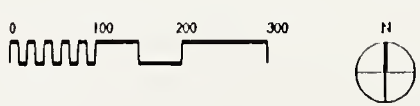


Figure 19 Melbourne Categories for Existing Conditions for S Winds



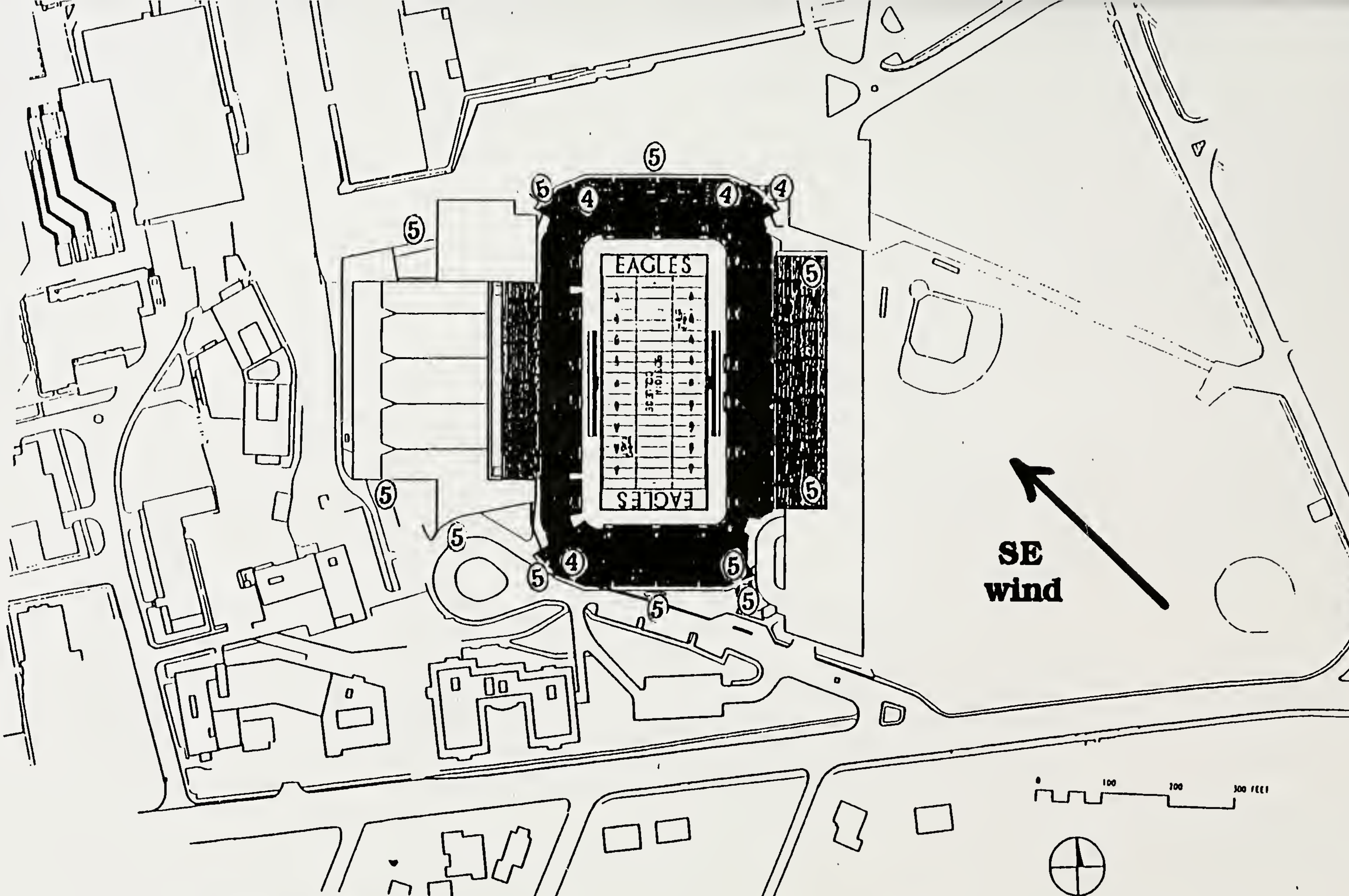


Figure 20 Melbourne Categories for Build Conditions for SE Winds